



ARIZONA DEPARTMENT OF TRANSPORTATION

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SMALL SIGN SUPPORT ANALYSIS

Phase II
Static, Pendulum and Full-Scale Crash Test Programs
Volume II (Appendices)

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16. Abstract <p>This report, in two volumes, compiles the static, pendulum and full-scale crash test results of alternative small sign support systems for Arizona Department of Transportation (ADOT). The tests were conducted and evaluated in accordance with the recommendations of NCHRP Report 230 and the 1985 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals."</p> <p>Results of this research indicate that three-3 lb/ft or (based on energy based analysis) two-4 lb/ft 80 ksi Marion steel u-post supports and stubs assembled using a 4 in. nested splice (support assembled behind the stub) with 1/2 in. spacers and grade 9 bolts, nuts and washers will meet the evaluation criteria. It also is apparent from the results of this study that a slip-base retrofit for a sign support system with up to three P2 Uni-Strut posts will meet the evaluation criteria.</p> <p>In all cases, tests were conducted in NCHRP Report 230 (2) Classification S1 (STRONG) soil. In cases where installation in a "weak" soil is anticipated, further evaluation is required.</p> <p>This report is one of three reports prepared in the subject project. The other two are: Small Sign Support Analysis: Phase I - Crash Test Program Phase III - Benefit/Cost Analysis</p>					
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Table A.1. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 3.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.38				Back to back; gr 5 bolts				
Dist to gauge (in) ...12.00				Critical orientation				
Moment arm (in)72.25								
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS	
(lbs)	Appl Total				(in)	(in)	At Gauge (uin/in)	(ksi)
		(mV)			Obs.	Calc.	Base	Gauge
	floor	1.951						
	DL	2.686		0.00	0.037	0.037	1.89	1.11
60	60	2.807	0.77	0.77	0.112	0.277	12.44	3.37
32	92	3.101	0.43	1.19	0.296	0.404	18.06	8.87
32	124	3.309	0.45	1.64	0.425	0.532	23.69	12.76
32	156	3.513	0.50	2.14	0.552	0.660	29.32	16.57
32	188	3.724	0.48	2.62	0.684	0.788	34.94	20.51
32	220	3.928	0.48	3.09	0.811	0.915	40.57	24.33
32	252	4.123	0.46	3.55	0.932	1.043	46.19	27.97
32	284	4.323	0.32	3.87	1.057	1.171	51.82	31.71
32	316	4.519	0.53	4.40	1.179	1.299	57.44	35.37
16	332	4.615	0.32	4.72	1.239	1.363	60.25	37.17
16	348	4.696	0.33	5.05	1.289	1.427	63.07	38.68

* Nominal yield stress

Table A.2. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 3.00				MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.50				Nested; gr 5 bolts					
Dist to gauge (in) ...11.75				Critical orientation					
Moment arm (in)72.06									
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS		
Appl	Total				(mV)	(in)	(in)	At Gauge (uin/in)	(ksi)
					Obs.	Calc.	Base		
	floor	1.851							
	DL	1.927		0.00	0.037	0.037	1.90	1.11	
60	60	2.324	0.90	0.90	0.283	0.277	12.42	8.50	
32	92	2.534	0.50	1.39	0.414	0.405	18.03	12.41	
48	140	2.743	0.51	1.90	0.544	0.597	26.45	16.31	
32	172	2.945	0.50	2.40	0.669	0.725	32.06	20.07	
32	204	3.141	0.49	2.89	0.791	0.853	37.67	23.72	
32	236	3.350	0.54	3.43	0.921	0.981	43.28	27.62	
32	268	3.542	0.52	3.95	1.040	1.109	48.89	31.19	
48	316	3.848	0.93	4.88	1.230	1.300	57.30	36.89	
16	332	3.946	0.33	5.21	1.291	1.364	60.11	38.72	
16	348	4.053	0.48	5.69	1.357	1.428	62.91	40.71	
16	364	4.148	0.50	6.19	1.416	1.492	65.72	42.48	
16	380	4.250	0.54	6.73	1.479	1.556	68.53	44.38	

* Nominal yield stress

Table A.3. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Face to Face Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 3.00			MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.75			Face to face; gr 5 bolts					
Dist to gauge (in) ... 8.25			Critical orientation					
Moment arm (in)72.62								
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS	
(lbs)	Appl				At Gauge	(ksi)	Obs @	Obs @
	Total	(mV)	(in)	(in)	Obs.	Calc.	Base	Gauge
	floor	2.259						
	DL	2.129		0.00	0.041	0.041	1.91	1.23
60	60	1.667	0.97	0.97	0.329	0.297	12.51	9.87
32	92	1.434	0.55	1.51	0.474	0.434	18.17	14.22
32	124	1.223	0.50	2.02	0.605	0.570	23.82	18.16
32	156	1.010	0.53	2.55	0.738	0.707	29.48	22.15
32	188	0.805	0.54	3.08	0.866	0.843	35.13	25.98
32	220	0.571	0.63	3.71	1.012	0.980	40.78	30.35
16	236	0.486	0.26	3.97	1.065	1.048	43.61	31.94
16	252	0.371	0.31	4.28	1.136	1.117	46.44	34.09
16	268	0.275	0.28	4.56	1.196	1.185	49.27	35.88
16	284	0.196	0.25	4.81	1.245	1.253	52.09	37.36
16	300	0.098	0.33	5.13	1.306	1.321	54.92	39.19
16	316	0.008	0.35	5.48	1.362	1.390	57.75	40.87
16	332	-0.096	0.45	5.93	1.427	1.458	60.58	42.82

* Nominal yield stress

Table A.4. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 3.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.38				Back to back; gr 5 bolts				
Dist to gauge (in) ... 7.88				Non-critical orientation				
Moment arm (in)72.38								
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS	
Appl	Total				(mV)	(in)	(in)	At Gauge (uin/in)
					Obs.	Calc.	Base	Gauge
floor		**						
	DL	8.242		0.00	0.042	0.042	1.89	1.26
60	60	7.848	0.74	0.74	0.287	0.298	12.46	8.62
32	92	7.661	0.38	1.11	0.404	0.435	18.09	12.12
32	124	7.471	0.39	1.50	0.522	0.572	23.73	15.67
32	156	7.266	0.41	1.91	0.650	0.709	29.36	19.50
32	188	7.068	0.43	2.34	0.773	0.845	35.00	23.20
32	220	6.878	0.46	2.79	0.892	0.982	40.63	26.76
32	252	6.653	0.55	3.34	1.032	1.119	46.27	30.96
32	284	6.446	0.50	3.84	1.161	1.256	51.90	34.83
32	316	6.252	0.51	4.34	1.282	1.392	57.54	38.46
32	348	6.052	0.67	5.01	1.406	1.529	63.17	42.19
16	364	5.980	0.66	5.66	1.451	1.598	65.99	43.54

* Nominal yield stress

** Strain gauge malfunction - data omitted

Table A.5. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 3.00				MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.50				Nested; gr 5 bolts					
Dist to gauge (in) ...12.00				Non-critical orientation					
Moment arm (in)72.37									
LOAD		Ch.#1	Tip Defl (in)	Total Defl (in)	STRAIN		STRESS		
(lbs)	Appl Total				(uin/in)	(ksi)	Obs	Calc.	Base
floor		1.949							
	DL	2.059		0.00	0.037	0.037	1.90	1.11	
60	60	1.652	0.92	0.92	0.291	0.277	12.46	8.72	
32	92	1.444	0.58	1.49	0.420	0.405	18.10	12.61	
32	124	1.221	0.52	2.01	0.559	0.533	23.73	16.77	
32	156	1.009	0.50	2.51	0.691	0.661	29.37	20.74	
32	188	0.696	0.75	3.26	0.886	0.789	35.00	26.59	
32	220	0.480	0.53	3.79	1.021	0.917	40.64	30.62	
32	252	0.277	0.51	4.29	1.147	1.045	46.27	34.42	
32	284	0.073	0.52	4.81	1.274	1.173	51.91	38.23	
32	316	-0.125	0.56	5.37	1.398	1.301	57.54	41.93	
32	348	-0.323	0.62	5.99	1.521	1.430	63.18	45.63	
16	364	-0.422	0.46	6.45	1.583	1.494	66.00	47.48	

* Nominal yield stress

Table A.6. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Face to Face Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 3.00				MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.31				Face to face; gr 5 bolts					
Dist to gauge (in) ... 7.75				Non-critical orientation					
Moment arm (in)72.19									
LOAD		Ch. #1	Tip	Total	STRAIN		STRESS		
(lbs)	Appl				Defl	Defl	At Gauge	(ksi)	Obs @
	Total	(mV)	(in)	(in)	Obs.	Calc.	Base	Gauge	
	floor	2.240							
	DL	2.328		0.00	0.042	0.042	1.89	1.26	
60	60	2.824	1.03	1.03	0.351	0.294	12.43	10.53	
32	92	3.032	0.47	1.50	0.481	0.429	18.05	14.42	
32	124	3.242	0.50	2.00	0.611	0.563	23.67	18.34	
32	156	3.469	0.55	2.55	0.753	0.698	29.29	22.59	
32	188	3.705	0.58	3.12	0.900	0.832	34.91	27.00	
32	220	3.909	0.52	3.64	1.027	0.967	40.53	30.81	
16	236	4.011	0.27	3.91	1.091	1.034	43.34	32.72	
16	252	4.115	0.28	4.18	1.155	1.101	46.15	34.66	
16	268	4.213	0.29	4.47	1.216	1.168	48.96	36.49	
16	284	4.327	0.33	4.79	1.287	1.236	51.77	38.62	
16	300	4.431	0.35	5.15	1.352	1.303	54.58	40.57	
16	316	4.539	0.37	5.52	1.420	1.370	57.39	42.59	
16	332	4.656	0.37	5.89	1.492	1.437	60.20	44.77	
16	348	4.757	0.45	6.34	1.555	1.505	63.01	46.66	
16	364	4.902	0.60	6.94	1.646	1.572	65.82	49.37	

* Nominal yield stress

Table A.7. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST							
Splice length (in) ... 4.00				MARION 3 lb/ft - 80 ksi *			
Dist to bolt A (in) .. 1.50				Back to back; gr 5 bolts			
Dist to gauge (in) ... 9.00				Critical orientation			
Moment arm (in)72.50							
LOAD (lbs)	Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
				Obs.	Calc.	Base	Obs @ Gauge
Appl	Total						
	floor	0.015					
	DL	0.049	0.00	0.041	0.041	1.90	1.23
60	60	0.459	0.78	0.296	0.293	12.48	8.89
32	92	0.668	0.41	0.427	0.428	18.13	12.80
32	124	0.884	0.43	0.561	0.562	23.77	16.84
32	156	1.106	0.43	0.700	0.697	29.42	20.99
32	188	1.321	0.42	0.834	0.832	35.06	25.01
32	220	1.536	0.43	0.967	0.966	40.71	29.02
32	252	1.536	0.43	0.967	1.101	46.35	29.02
32	284	1.772	0.50	1.115	1.236	52.00	33.44
32	316	1.979	0.47	1.243	1.370	57.64	37.30
32	348	2.175	0.47	1.366	1.505	63.28	40.97
16	364	2.293	0.30	1.439	1.572	66.11	43.17
32	396	2.502	0.43	1.569	1.707	71.75	47.08
16	412	2.630	0.35	1.649	1.774	74.57	49.47
16	428	2.728	0.27	1.710	1.842	77.40	51.30
16	444	2.828	0.28	1.772	1.909	80.22	53.17
16	460	2.912	0.27	1.825	1.976	83.04	54.74
16	476	3.013	0.35	1.888	2.044	85.86	56.63
16	492	3.104	0.33	1.944	2.111	88.69	58.33

* Nominal yield stress

Table A.8. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.50				Nested; gr 5 bolts				
Dist to gauge (in) ... 8.88				Critical orientation				
Moment arm (in)73.38								
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	2.251						
	DL	8.706		0.00	**	0.041	1.90	**
60	60	12.700	0.81	0.81	0.297	0.297	12.61	8.91
32	92	12.890	0.52	1.33	0.415	0.434	18.35	12.46
32	124	13.110	0.45	1.78	0.552	0.571	24.09	16.57
32	156	13.330	0.45	2.23	0.690	0.708	29.83	20.69
32	188	13.530	0.43	2.67	0.814	0.844	35.57	24.42
32	220	13.730	0.46	3.13	0.939	0.981	41.31	28.16
32	252	13.910	0.41	3.53	1.051	1.118	47.05	31.53
32	284	14.110	0.42	3.96	1.176	1.255	52.80	35.27
32	316	14.370	0.53	4.49	1.338	1.391	58.54	40.13
32	348	14.580	0.48	4.96	1.468	1.528	64.28	44.05
32	380	14.790	0.51	5.47	1.599	1.665	70.02	47.98
32	412	15.010	0.55	6.02	1.736	1.802	75.76	52.09
16	428	15.140	0.38	6.40	1.817	1.870	78.63	54.52
16	444	15.270	0.40	6.80	1.898	1.939	81.50	56.95
16	460	15.390	0.54	7.33	1.973	2.007	84.37	59.19
16	476	15.530	0.57	7.90	2.060	2.075	87.24	61.81

* Nominal yield stress

** Strain gauge malfunction - data omitted

Table A.9. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00			MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.25			Face to face; gr 5 bolts					
Dist to gauge (in) ... 8.75			Critical orientation					
Moment arm (in)72.25								
LOAD (lbs)	Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)		
				Obs.	Calc.	Base	Obs @ Gauge	
Appl	Total							
floor	2.423							
DL	2.244		0.00	0.041	0.041	1.90	1.23	
60	60	1.831	0.82	0.82	0.298	0.293	12.45 8.95	
32	92	1.624	0.40	1.22	0.427	0.428	18.07 12.82	
32	124	1.415	0.42	1.64	0.558	0.563	23.70 16.73	
32	156	1.201	0.45	2.09	0.691	0.697	29.32 20.73	
32	188	0.993	0.43	2.52	0.820	0.832	34.95 24.61	
32	220	0.783	0.45	2.97	0.951	0.967	40.57 28.54	
32	252	0.547	0.51	3.48	1.098	1.101	46.20 32.95	
32	284	0.325	0.49	3.97	1.237	1.236	51.82 37.10	
32	316	0.106	0.50	4.47	1.373	1.371	57.45 41.19	
32	348	-0.134	0.57	5.04	1.523	1.505	63.07 45.68	
16	364	-0.260	0.32	5.36	1.601	1.573	65.89 48.03	
16	380	-0.345	0.24	5.60	1.654	1.640	68.70 49.62	
16	396	-0.465	0.35	5.94	1.729	1.707	71.51 51.87	
16	412	-0.582	0.42	6.36	1.802	1.775	74.32 54.05	
16	428	-0.702	0.52	6.88	1.877	1.842	77.14 56.30	

* Nominal yield stress

Table A.10. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00			MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.38			Back to back; gr 5 bolts					
Dist to gauge (in) ... 8.88			Non-critical orientation					
Moment arm (in)73.31								
LOAD			Tip		STRAIN		STRESS	
(lbs)	Ch.#1		Defl	Total	At Gauge		(ksi)	
Appl	Total	(mV)	(in)	(in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	-0.129						
	DL	-0.231		0.00	0.041	0.041	1.89	1.23
60	60	-0.646	0.68	0.68	0.300	0.297	12.59	8.99
32	92	-0.863	0.37	1.05	0.435	0.434	18.30	13.04
32	124	-1.083	0.37	1.41	0.572	0.570	24.01	17.16
32	156	-1.283	0.36	1.77	0.696	0.707	29.72	20.89
32	188	-1.485	0.36	2.13	0.822	0.843	35.43	24.67
32	220	-1.701	0.39	2.52	0.957	0.980	41.13	28.71
32	252	-1.905	0.37	2.89	1.084	1.117	46.84	32.52
32	284	-2.137	0.42	3.31	1.229	1.253	52.55	36.86
32	316	-2.346	0.39	3.70	1.359	1.390	58.26	40.76
32	348	-2.544	0.38	4.08	1.482	1.527	63.97	44.46
32	380	-2.769	0.44	4.52	1.622	1.663	69.67	48.67
32	412	-2.993	0.47	4.99	1.762	1.800	75.38	52.86
16	428	-3.103	0.35	5.33	1.830	1.868	78.24	54.91
16	444	-3.220	0.28	5.62	1.903	1.936	81.09	57.10
16	460	-3.322	0.27	5.89	1.967	2.005	83.95	59.01
16	476	-3.438	0.36	6.24	2.039	2.073	86.80	61.17

* Nominal yield stress

Table A.11. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST							
Splice length (in) ... 4.00				MARION 3 lb/ft - 80 ksi *			
Dist to bolt A (in) .. 1.75				Nested; gr 5 bolts			
Dist to gauge (in) ... 7.25				Non-critical orientation			
Moment arm (in)73.75							
LOAD (lbs)	Ch. #1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
				Obs.	Calc.	Base	Obs @ Gauge
Appl	Total						
	floor	2.238					
	DL	2.191		0.00	0.043	0.043	1.91 1.29
60	60	1.770	0.86	0.86	0.304	0.307	12.68 9.13
32	92	1.561	0.44	1.30	0.434	0.448	18.42 13.02
48	140	1.222	0.72	2.02	0.645	0.660	27.03 19.34
32	172	1.005	0.46	2.47	0.779	0.801	32.77 23.38
32	204	0.774	0.50	2.97	0.923	0.942	38.52 27.68
32	236	0.543	0.48	3.45	1.066	1.083	44.26 31.99
32	268	0.329	0.45	3.90	1.199	1.224	50.00 35.97
32	300	0.107	0.47	4.36	1.337	1.365	55.74 40.11
32	332	-0.121	0.48	4.84	1.479	1.506	61.48 44.36
32	364	-0.347	0.49	5.32	1.619	1.647	67.23 48.57
32	396	-0.558	0.47	5.79	1.750	1.788	72.97 52.50
16	412	-0.651	0.22	6.01	1.808	1.858	75.84 54.23
16	428	-0.752	0.25	6.26	1.870	1.929	78.71 56.11
16	444	-0.867	0.31	6.57	1.942	1.999	81.58 58.25
16	460	-0.962	0.29	6.85	2.001	2.070	84.45 60.02
16	476	-1.078	0.36	7.21	2.073	2.140	87.32 62.19
16	492	-1.209	0.48	7.69	2.154	2.211	90.19 64.63
16	508	-1.295	0.26	7.95	2.208	2.281	93.07 66.23

* Nominal yield stress

Table A.12. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST							
Splice length (in) ... 4.00				MARION 3 lb/ft - 80 ksi *			
Dist to bolt A (in) .. 1.44				Face to face; gr 5 bolts			
Dist to gauge (in) ... 9.00				Non-critical orientation			
Moment arm (in)72.38							
LOAD (lbs)	Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
				Obs.	Calc.	Base	Obs @ Gauge
Appl	Total						
	floor	2.235					
	DL	2.442		0.00	0.041	0.041	1.90 1.23
60	60	2.849	0.88	0.88	0.295	0.293	12.52 8.84
32	92	3.041	0.40	1.28	0.414	0.427	18.18 12.43
32	124	3.255	0.45	1.73	0.548	0.561	23.85 16.43
32	156	3.478	0.47	2.20	0.686	0.696	29.51 20.59
32	188	3.711	0.49	2.68	0.832	0.830	35.17 24.95
32	220	3.927	0.46	3.14	0.966	0.965	40.83 28.99
32	252	4.139	0.47	3.61	1.098	1.099	46.50 32.95
32	284	4.358	0.48	4.09	1.235	1.233	52.16 37.04
32	316	4.598	0.55	4.64	1.384	1.368	57.82 41.53
32	348	4.808	0.51	5.14	1.515	1.502	63.49 45.45
32	380	5.006	0.51	5.65	1.639	1.637	69.15 49.16
32	412	5.204	0.59	6.24	1.762	1.771	74.81 52.86
16	428	5.310	0.31	6.55	1.828	1.838	77.64 54.84
16	444	5.398	0.35	6.90	1.883	1.905	80.47 56.48
16	460	5.506	0.40	7.30	1.950	1.972	83.30 58.50
16	476	5.603	0.41	7.71	2.010	2.040	86.14 75.26

* Nominal yield stress

Table A.13. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 5.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.38				Back to back; gr 5 bolts				
Dist to gauge (in) ...10.00				Critical orientation				
Moment arm (in)73.38								
LOAD		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN		STRESS	
Appl	Total				At Gauge (uin/in)		(ksi)	
					Obs.	Calc.	Base	Obs @ Gauge
	floor	1.762						
	DL	2.172		0.00	0.039	0.039	1.90	1.17
60	60	2.585	0.67	0.67	0.296	0.287	12.61	8.89
32	92	2.818	0.40	1.07	0.442	0.420	18.32	13.25
32	124	3.046	0.40	1.46	0.584	0.552	24.04	17.51
32	156	3.276	0.40	1.86	0.727	0.684	29.75	21.81
32	188	3.502	0.39	2.25	0.868	0.817	35.46	26.03
32	220	3.735	0.40	2.65	1.013	0.949	41.17	30.39
32	252	3.963	0.40	3.05	1.155	1.081	46.89	34.65
32	284	4.194	0.41	3.46	1.299	1.214	52.60	38.97
32	316	4.408	0.40	3.86	1.432	1.346	58.31	42.97
32	348	4.614	0.39	4.25	1.561	1.478	64.03	46.82
32	380	4.834	0.42	4.67	1.698	1.610	69.74	50.93
32	412	5.051	0.42	5.09	1.833	1.743	75.45	54.98
32	444	5.278	0.45	5.53	1.974	1.875	81.16	59.23
32	476	5.492	0.44	5.97	2.108	2.007	86.88	63.23
32	508	5.705	0.50	6.46	2.240	2.140	92.59	67.21
32	540	5.872	0.43	6.89	2.344	2.272	98.30	70.33
16	556	5.965	0.34	7.23	2.402	2.338	101.16	72.07

* Nominal yield stress

Table A.14. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 5.00				MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.44				Nested; gr 5 bolts					
Dist to gauge (in) ...10.00				Critical orientation					
Moment arm (in)72.38									
LOAD		Ch.#1	Tip	Total	STRAIN		STRESS		Obs @
(lbs)	Appl Total				Defl	Defl	At Gauge	(ksi)	
		(mV)	(in)	(in)	(uin/in)				
					Obs.	Calc.			
floor		2.034							
DL		2.413		0.00	0.039	0.039	1.90	1.17	
60	60	2.810	0.75	0.75	0.286	0.287	12.46	8.59	
32	92	3.025	0.40	1.15	0.420	0.420	18.10	12.61	
32	124	3.237	0.41	1.56	0.552	0.552	23.73	16.57	
32	156	3.454	0.43	1.99	0.688	0.684	29.37	20.63	
32	188	3.664	0.41	2.40	0.818	0.816	35.00	24.55	
32	220	3.902	0.47	2.87	0.967	0.949	40.64	29.00	
32	252	4.091	0.37	3.24	1.084	1.081	46.27	32.53	
32	284	4.302	0.42	3.66	1.216	1.213	51.91	36.48	
32	316	4.518	0.43	4.09	1.351	1.346	57.54	40.52	
32	348	4.721	0.41	4.50	1.477	1.478	63.18	44.31	
32	380	4.904	0.38	4.87	1.591	1.610	68.81	47.73	
32	412	5.101	0.41	5.28	1.714	1.742	74.45	51.41	
32	444	5.289	0.39	5.67	1.831	1.875	80.08	54.93	
32	476	5.504	0.47	6.14	1.965	2.007	85.72	58.95	
32	508	5.729	0.52	6.65	2.105	2.139	91.35	63.15	
32	540	5.918	0.49	7.14	2.223	2.271	96.99	66.68	
32	572	6.165	0.75	7.88	2.377	2.404	102.62	71.30	
16	588	6.303	0.41	8.29	2.463	2.470	105.44	73.88	

* Nominal yield stress

Table A.15. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Face to Face Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 5.00			MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.88			Face to face; gr 5 bolts					
Dist to gauge (in) ...10.50			Critical orientation					
Moment arm (in)72.88								
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	0.870						
	DL	0.667		0.00	0.039	0.039	1.90	1.17
60	60	0.271	0.78	0.78	0.286	0.287	12.54	8.57
32	92	0.061	0.41	1.19	0.417	0.419	18.21	12.50
32	124	-0.144	0.42	1.60	0.544	0.551	23.88	16.33
32	156	-0.335	0.39	2.00	0.663	0.684	29.56	19.90
32	188	-0.535	0.41	2.41	0.788	0.816	35.23	23.64
32	220	-0.745	0.44	2.85	0.919	0.948	40.91	27.56
32	252	-0.946	0.43	3.27	1.044	1.081	46.58	31.32
32	284	-1.170	0.47	3.75	1.184	1.213	52.25	35.51
32	316	-1.358	0.41	4.16	1.301	1.345	57.93	39.02
32	348	-1.571	0.45	4.61	1.433	1.477	63.60	43.00
32	380	-1.786	0.47	5.07	1.567	1.610	69.28	47.02
32	412	-1.977	0.42	5.49	1.686	1.742	74.95	50.59
16	428	-2.076	0.23	5.71	1.748	1.808	77.79	52.44
16	444	-2.171	0.22	5.93	1.807	1.874	80.62	54.22
16	460	-2.266	0.24	6.17	1.866	1.940	83.46	55.99
16	476	-2.391	0.32	6.49	1.944	2.006	86.30	58.33
16	492	-2.520	0.34	6.83	2.025	2.073	89.14	60.74
16	508	-2.623	0.31	7.13	2.089	2.139	91.97	62.67
16	524	-2.750	0.37	7.50	2.168	2.205	94.81	65.04
16	540	-2.838	0.29	7.78	2.223	2.271	97.65	66.68
16	556	-2.943	0.34	8.12	2.288	2.337	100.48	68.65
16	572	-3.042	0.40	8.52	2.350	2.403	103.32	70.50

* Nominal yield stress

Table A.16. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Back to Back Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 5.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.75				Back to back; gr 5 bolts				
Dist to gauge (in) ...10.25				Non-critical orientation				
Moment arm (in)73.75								
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS	
Appl	Total				(mV)	(in)	(in)	At Gauge (uin/in)
					Obs.	Calc.	Base	Gauge
	floor	1.897						
	DL	1.704		0.00	0.048	0.048	1.90	1.44
60	60	1.300	0.73	0.73	0.300	0.357	12.66	8.99
32	92	1.079	0.41	1.14	0.437	0.522	18.41	13.12
32	124	0.863	0.41	1.55	0.572	0.687	24.15	17.16
32	156	0.652	0.41	1.96	0.703	0.851	29.89	21.10
32	188	0.418	0.46	2.42	0.849	1.016	35.63	25.48
32	220	0.202	0.43	2.85	0.984	1.181	41.38	29.51
32	252	-0.017	0.44	3.28	1.120	1.346	47.12	33.61
32	284	-0.236	0.44	3.72	1.257	1.511	52.86	37.70
32	316	-0.455	0.44	4.15	1.393	1.675	58.60	41.79
32	348	-0.677	0.44	4.59	1.531	1.840	64.34	45.94
32	380	-0.902	0.46	5.05	1.672	2.005	70.09	50.15
32	412	-1.118	0.44	5.48	1.806	2.170	75.83	54.19
32	444	-1.347	0.48	5.96	1.949	2.335	81.57	58.47
32	476	-1.539	0.41	6.36	2.069	2.499	87.31	62.06
32	508	-1.738	0.44	6.80	2.193	2.664	93.05	65.78
32	540	-1.957	0.53	7.32	2.329	2.829	98.80	69.87
16	556	-2.038	0.24	7.56	2.379	2.911	101.67	71.38
16	572	-2.162	0.35	7.90	2.457	2.994	104.54	73.70
16	588	-2.263	0.38	8.28	2.520	3.076	107.41	75.59
12	600	-2.242	0.22	8.50	2.507	3.138	109.56	75.20

* Nominal yield stress

Table A.17. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Nested Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 5.00			MARION 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.63			Nested; gr 5 bolts					
Dist to gauge (in) ...10.19			Non-critical orientation					
Moment arm (in)72.38								
LOAD		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN		STRESS	
Appl	Total				At Gauge (uin/in)		(ksi)	
					Obs.	Calc.	Base	Obs @ Gauge
	floor	2.218						
	DL	2.042		0.00	0.039	0.039	1.90	1.17
60	60	1.640	0.77	0.77	0.289	0.286	12.47	8.68
32	92	1.424	0.41	1.18	0.424	0.418	18.10	12.72
32	124	1.207	0.42	1.60	0.559	0.550	23.74	16.78
32	156	0.986	0.42	2.02	0.697	0.682	29.37	20.91
32	188	0.763	0.43	2.45	0.836	0.814	35.01	25.08
32	220	0.553	0.40	2.85	0.967	0.946	40.65	29.00
32	252	0.360	0.37	3.22	1.087	1.078	46.28	32.61
32	284	0.152	0.40	3.63	1.217	1.210	51.92	36.50
32	316	-0.057	0.41	4.04	1.347	1.341	57.55	40.40
32	348	-0.279	0.43	4.46	1.485	1.473	63.19	44.55
32	380	-0.478	0.41	4.87	1.609	1.605	68.82	48.27
32	412	-0.673	0.39	5.26	1.731	1.737	74.46	51.92
32	444	-0.864	0.38	5.64	1.850	1.869	80.09	55.49
32	476	-1.059	0.40	6.04	1.971	2.001	85.73	59.13
32	508	-1.254	0.41	6.45	2.093	2.133	91.36	62.78
32	540	-1.434	0.39	6.84	2.205	2.265	97.00	66.14
32	572	-1.652	0.48	7.32	2.341	2.396	102.63	70.22
16	588	-1.743	0.21	7.53	2.397	2.462	105.45	71.92
16	604	-1.871	0.36	7.89	2.477	2.528	108.27	74.31
16	620	-1.934	0.19	8.08	2.516	2.594	111.08	75.49
28	648	-2.036	0.31	8.39	2.580	2.710	116.01	77.39
16	664	-2.122	0.31	8.70	2.633	2.776	118.83	79.00
16	680	-2.286	0.30	9.00	2.736	2.842	121.65	82.07

* Nominal yield stress

Table A.18. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Face to Face Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 5.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.38				Face to face; gr 5 bolts				
Dist to gauge (in) ... 9.81				Non-critical orientation				
Moment arm (in)72.38								
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	0.792						
	DL	1.011		0.00				
60	60	1.467	0.84	0.84	0.040	0.040	1.89	1.20
32	92	1.665	0.38	1.22	0.324	0.288	12.46	9.72
32	124	1.801	0.41	1.63	0.447	0.421	18.09	13.42
32	156	2.095	0.41	2.03	0.532	0.554	23.73	15.97
32	188	2.325	0.44	2.47	0.715	0.687	29.36	21.46
32	220	2.527	0.39	2.86	0.859	0.819	35.00	25.76
32	252	2.702	0.39	2.86	0.985	0.952	40.63	29.54
32	284	2.895	0.35	3.21	1.094	1.085	46.27	32.81
32	316	2.895	0.39	3.60	1.214	1.217	51.90	36.41
32	348	3.144	0.50	4.10	1.369	1.350	57.54	41.07
32	380	3.338	0.38	4.48	1.490	1.483	63.17	44.70
32	412	3.544	0.41	4.89	1.618	1.615	68.81	48.55
32	444	3.764	0.44	5.33	1.755	1.748	74.44	52.66
32	488	3.984	0.47	5.79	1.892	1.881	80.08	56.77
16	460	4.112	0.28	6.07	1.972	1.947	82.90	59.16
16	476	4.210	0.23	6.29	2.033	2.013	85.71	60.99
16	492	4.330	0.31	6.60	2.108	2.080	88.53	63.24
16	508	4.451	0.33	6.93	2.183	2.146	91.35	65.50
16	524	4.569	0.35	7.28	2.257	2.212	94.17	67.70
16	540	4.692	0.38	7.66	2.333	2.279	96.98	70.00
16	556	4.815	0.37	8.03	2.410	2.345	99.80	72.30
16	572	4.943	0.40	8.42	2.490	2.411	102.62	74.70
16	588	5.092	0.50	8.92	2.583	2.478	105.44	77.48

* Nominal yield stress

APPENDIX B

17 " BENDING TESTS

FIELD BOLT SUMMARY TABLES

Franklin 3 & 4 lb/ft Posts - 60 ksi Nominal Yield Stress

Marion 3 & 4 lb/ft Posts - 80 ksi Nominal Yield Stress

Back to Back, Nested and Face to Face Splices

Critical and Non-critical Configurations

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Table B.1. Results of 17 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 3.00					FRANKLIN 3 lb/ft - 60 ksi *			
Dist to bolt A (in) .. 1.44					Back to back; gr 5 bolts			
Dist to gauge (in) ... 8.13					Critical orientation			
Moment arm (in)16.44								
LOAD (lbs)		Ch.#1 (mV)	Read (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	0.704						
	DL	0.838			-0.052	-0.052	1.94	-1.55
0	0	0.849	-1.22	0.00	-0.059	-0.052	1.94	-1.76
200	200	1.076	-1.31	0.09	-0.200	-0.189	10.09	-6.00
200	400	1.131	-1.40	0.18	-0.234	-0.327	18.25	-7.03
200	600	1.532	-1.49	0.27	-0.484	-0.464	26.41	-14.52
200	800	1.764	-1.58	0.37	-0.629	-0.602	34.57	-18.86
200	1000	1.982	-1.69	0.47	-0.764	-0.739	42.73	-22.93
200	1200	2.217	-1.80	0.58	-0.911	-0.877	50.89	-27.33
100	1300	2.326	-1.87	0.65	-0.979	-0.945	54.97	-29.36
100	1400	2.420	-1.97	0.75	-1.037	-1.014	59.05	-31.12
100	1500	2.545	-2.07	0.85	-1.115	-1.083	63.13	-33.46
43	1543						64.88	

* Nominal yield stress

Table B.2. Results of 17 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 3.00				FRANKLIN 3 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.75				Nested; gr 5 bolts				
Dist to gauge (in) ... 8.31				Critical orientation				
Moment arm (in)16.75								
LOAD (lbs)		Ch.#1 (mV)	Read (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	0.644						
	DL	0.589			0.052	0.052	1.94	1.55
0	0	0.606	-0.69	0.00	0.041	0.052	1.94	1.23
200	200	0.396	-0.79	0.10	0.172	0.191	10.25	5.74
200	400	0.153	-0.90	0.21	0.323	0.331	18.56	9.93
200	600	-0.083	-1.01	0.32	0.470	0.471	26.87	14.12
200	800	-0.335	-1.13	0.44	0.627	0.610	35.19	18.30
200	1000	-0.588	-1.26	0.57	0.785	0.750	43.50	22.49
200	1200	-0.849	-1.40	0.72	0.948	0.889	51.81	26.68
200	1400	-1.141	-1.65	0.96	1.130	1.029	60.12	30.87
100	1500	-1.261	-1.83	1.14	1.204	1.099	64.28	32.96
346	1846		-2.49	1.80			78.66	

* Nominal yield stress

- Stub cracked and allowed increased load and deflection prior to bolt failure - bolt fails at 1846 lbs

Table B.3. Results of 17 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Face to Face Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 3.00					FRANKLIN 3 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.75					Face to face; gr 5 bolts				
Dist to gauge (in) ... 8.25					Critical orientation				
Moment arm (in)16.75									
LOAD		Ch.#1	Tip	Total	STRAIN		STRESS		
(lbs)	(mV)				Defl	Defl	At Gauge	(ksi)	Obs @
Appl	Total		(in)	(in)	Obs.	Calc.	Base	Gauge	
	floor	1.191							
	DL	1.259			0.052	0.052	1.94	1.55	
0	0	1.277	-1.33	0.00	0.040	0.052	1.94	1.21	
200	200	1.084	-1.43	0.10	0.161	0.188	10.25	4.82	
200	400	0.871	-1.52	0.20	0.293	0.325	18.56	8.80	
200	600	0.671	-1.63	0.30	0.418	0.461	26.87	12.54	
200	800	0.452	-1.79	0.46	0.555	0.598	35.19	16.64	
200	1000	0.224	-1.97	0.64	0.697	0.734	43.50	20.90	
200	1200	-0.001	-2.20	0.88	0.837	0.871	51.81	25.10	
100	1300	-0.118	-2.46	1.13	0.910	0.939	55.97	27.29	
67	1367	-0.194	-2.98	1.66	0.957	0.985	58.75	28.71	

* Nominal yield stress

- Stub cracked and allowed increased load and deflection - bolt did not fail - stroke limit reached at -2.98 in

Table B.4. Results of 17 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Back to Back Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 3.00				FRANKLIN 3 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.75				Back to back; gr 5 bolts				
Dist to gauge (in) ... 8.25				Non-critical orientation				
Moment arm (in)16.75								
LOAD (lbs)		Ch. #1 (mV)	Total		STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total		Read (in)	Defl (in)	Obs.	Calc.	Base	Obs @ Gauge
	Floor	-1.134						
	DL	-1.320			0.052	0.052	1.94	1.55
0	0	-1.327	0.75	0.00	0.056	0.052	1.94	1.68
200	200	-1.588	0.66	0.09	0.219	0.192	10.25	6.56
200	400	-1.832	0.56	0.18	0.371	0.333	18.56	11.12
200	600	-2.105	0.47	0.28	0.541	0.474	26.87	16.22
200	800	-2.376	0.37	0.38	0.710	0.614	35.19	21.29
200	1000	-2.654	0.27	0.48	0.883	0.755	43.50	26.49
200	1200	-2.948	0.17	0.57	1.066	0.895	51.81	31.98
200	1400	-3.260	0.06	0.69	1.260	1.036	60.12	37.81
100	1500	-3.438	-0.02	0.76	1.371	1.106	64.28	41.14
100	1600	-3.613	-0.12	0.86	1.480	1.177	68.44	44.41
100	1700	-3.803	-0.24	0.99	1.599	1.247	72.59	47.96
75	1775	-3.895	-0.36	1.10	1.656	1.300	75.71	49.68
75	1850	-4.135	-0.49	1.23	1.806	1.352	78.83	54.17
50	1900	-4.267	-0.60	1.34	1.888	1.388	80.91	56.64
50	1950	-4.414	-0.79	1.53	1.979	1.423	82.98	59.38
56	2006						85.31	

* Nominal yield stress

Table B.5. Results of 17 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Nested Splice in Non-critical Configuration (Grade 5 Field Bolts).

					BENDING TEST			
Splice length (in) ... 3.00					FRANKLIN 3 lb/ft - 60 ksi *			
Dist to bolt A (in) .. 1.38					Nested; gr 5 bolts			
Dist to gauge (in) ... 8.13					Non-critical orientation			
Moment arm (in)16.38								
LOAD (lbs)		Ch.#1 (mV)	Read (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	Floor	1.092						
	DL	1.240			-0.052	-0.052	1.94	-1.55
0	0	1.203	1.42	0.00	-0.029	-0.052	1.94	-0.86
200	200	1.436	1.32	0.10	-0.174	-0.188	10.06	-5.21
200	400	1.661	1.23	0.19	-0.314	-0.325	18.19	-9.42
200	600	1.870	1.13	0.29	-0.444	-0.461	26.32	-13.33
200	800	2.102	1.03	0.40	-0.589	-0.598	34.45	-17.66
200	1000	2.326	0.92	0.50	-0.728	-0.734	42.58	-21.85
200	1200	2.568	0.81	0.62	-0.879	-0.871	50.71	-26.37
100	1300	2.688	0.74	0.68	-0.954	-0.939	54.77	-28.62
100	1400	2.816	0.66	0.76	-1.034	-1.007	58.84	-31.01
100	1500	2.937	0.58	0.85	-1.109	-1.076	62.90	-33.27
100	1600	3.095	0.43	1.00	-1.207	-1.144	66.97	-36.22
100	1700	3.250	0.28	1.14	-1.304	-1.212	71.03	-39.12
100	1800	3.410	0.11	1.31	-1.404	-1.280	75.10	-42.11
100	1900	3.615	-0.13	1.55	-1.531	-1.348	79.16	-45.94
100	2000	3.831	-0.40	1.82	-1.666	-1.417	83.23	-49.98
53	2053						85.38	

* Nominal yield stress

Table B.6. Results of 17 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Face to Face Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 3.00				FRANKLIN 3 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.69				Face to face; gr 5 bolts				
Dist to gauge (in) ... 8.13				Non-critical orientation				
Moment arm (in)16.69								
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS	
Apppl	Total				(mV)	(in)	(in)	At Gauge
					Obs.	Calc.	Base	Gauge
	floor	1.216						
	DL	1.386			-0.052	-0.052	1.94	-1.55
0	0	1.391	2.28	0.00	-0.055	-0.052	1.94	-1.64
200	200	1.573	2.20	0.08	-0.168	-0.194	10.22	-5.05
200	400	1.786	2.10	0.18	-0.301	-0.335	18.50	-9.03
200	600	2.010	2.00	0.29	-0.440	-0.477	26.78	-13.21
200	800	2.231	1.89	0.39	-0.578	-0.618	35.07	-17.35
200	1000	2.458	1.78	0.51	-0.720	-0.760	43.35	-21.59
200	1200	2.727	1.64	0.64	-0.887	-0.902	51.63	-26.62
200	1400	2.983	1.46	0.82	-1.047	-1.043	59.92	-31.40
100	1500	3.196	1.24	1.04	-1.179	-1.114	64.06	-35.38
50	1550	3.252	1.15	1.13	-1.214	-1.149	66.13	-36.43
50	1600	3.357	1.06	1.23	-1.280	-1.185	68.20	-38.39
50	1650	3.457	0.92	1.36	-1.342	-1.220	70.27	-40.26
50	1700	3.598	0.59	1.69	-1.430	-1.256	72.34	-42.90

* Nominal yield stress

- End of post (79 in) displaces 18 in laterally

Table B.7. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

					BENDING TEST			
Splice length (in) ... 4.00					FRANKLIN 4 lb/ft - 60 ksi *			
Dist to bolt A (in) .. 1.50					Back to back; gr 5 bolts			
Dist to gauge (in) ... 9.19					Critical orientation			
Moment arm (in)17.50								
LOAD (lbs)		Ch.#1 (mV)	Total		STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total		Read	Defl	Obs.	Calc.	Base	Obs @ Gauge
			(in)	(in)				
	floor	-0.238						
	DL	-0.075			-0.048	-0.048	1.86	-1.44
0	0	-0.076	-1.09	0.00	-0.047	-0.048	1.86	-1.42
200	200	0.084	-1.18	0.09	-0.147	-0.147	8.11	-4.41
200	400	0.254	-1.26	0.17	-0.253	-0.246	14.36	-7.59
200	600	0.418	-1.33	0.24	-0.355	-0.345	20.61	-10.65
200	800	0.594	-1.41	0.32	-0.465	-0.444	26.86	-13.94
200	1000	0.773	-1.49	0.40	-0.576	-0.543	33.11	-17.29
200	1200	0.952	-1.56	0.47	-0.688	-0.642	39.36	-20.64
200	1400	1.137	-1.65	0.56	-0.803	-0.741	45.61	-24.09
200	1600	1.319	-1.76	0.67	-0.917	-0.840	51.86	-27.50
100	1700	1.416	-1.88	0.79	-0.977	-0.889	54.98	-29.31
51	1751						56.58	

* Nominal yield stress

Table B.8. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

				BENDING TEST				
Splice length (in) ... 4.00				FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.63				Nested; gr 5 bolts				
Dist to gauge (in) ... 9.25				Critical orientation				
Moment arm (in)16.63								
LOAD (lbs)		Ch.#1 (mV)	Read (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	0.145						
	DL	0.065			0.049	0.049	1.86	1.48
0	0	0.061	-0.90	0.00	0.052	0.049	1.86	1.55
200	200	-0.082	-0.96	0.06	0.141	0.136	7.80	4.22
200	400	-0.232	-1.02	0.12	0.234	0.224	13.74	7.03
200	600	-0.372	-1.09	0.19	0.321	0.312	19.68	9.64
200	800	-0.514	-1.16	0.26	0.410	0.400	25.61	12.30
200	1000	-0.673	-1.22	0.32	0.509	0.488	31.55	15.27
200	1200	-0.819	-1.28	0.39	0.600	0.576	37.49	18.00
200	1400	-0.981	-1.35	0.46	0.701	0.664	43.43	21.03
200	1600	-1.130	-1.43	0.53	0.794	0.751	49.37	23.81
100	1700	-1.315	-1.47	0.58	0.909	0.795	52.34	27.27
100	1800	-1.294	-1.53	0.63	0.896	0.839	55.31	26.88
100	1900	-1.381	-1.57	0.67	0.950	0.883	58.28	28.50
100	2000	-1.455	-1.63	0.74	0.996	0.927	61.25	29.89

* Nominal yield stress

Table B.9. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Nested Splice in Critical Configuration; Assembled Backwards (Grade 5 Field Bolts).

				BENDING TEST				
Splice length (in) ... 4.00				FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.56				Nested; gr 5 bolts				
Dist to gauge (in) ... 9.19				Critical (backwards)				
Moment arm (in)16.56								
LOAD		Ch.#1	Tip Total		STRAIN		STRESS	
Appl	Total		Defl	Defl	At Gauge	(ksi)	Obs @	
		(mV)	(in)	(in)	(uin/in)		Base	Gauge
					Obs.	Calc.		
	floor	0.088						
	DL	0.128			-0.048	-0.048	1.86	-1.44
0	0	0.119	-0.27	0.00	-0.042	-0.048	1.86	-1.27
200	200	0.260	-0.34	0.07	-0.130	-0.136	7.77	-3.91
200	400	0.413	-0.40	0.13	-0.226	-0.224	13.69	-6.77
200	600	0.558	-0.47	0.20	-0.316	-0.312	19.60	-9.48
200	800	0.711	-0.51	0.24	-0.411	-0.399	25.51	-12.34
200	1000	0.876	-0.60	0.33	-0.514	-0.487	31.43	-15.42
200	1200	1.022	-0.67	0.40	-0.605	-0.575	37.34	-18.15
200	1400	1.191	-0.74	0.47	-0.710	-0.663	43.26	-21.31
200	1600	1.341	-0.82	0.55	-0.804	-0.750	49.17	-24.11
200	1800	1.493	-0.90	0.63	-0.898	-0.838	55.09	-26.95
200	2000	1.654	-1.00	0.73	-0.999	-0.926	61.00	-29.96
80	2080	1.704	-1.11	0.84	-1.030	-0.961	63.37	-30.90
17	2097						63.87	

* Nominal yield stress

Table B.10. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Face to Face Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.50				Face to face; gr 5 bolts				
Dist to gauge (in) ... 9.13				Critical orientation				
Moment arm (in)16.50								
LOAD (lbs)		Ch.#1 (mV)	Tip Total Defl (in)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total		Defl	Defl	Obs.	Calc.	Base	Obs @ Gauge
	floor	-0.100						
	DL	-0.158			0.048	0.048	1.86	1.44
0	0	-0.169	-1.34	0.00	0.055	0.048	1.86	1.64
200	200	-0.322	-1.42	0.08	0.150	0.136	7.75	4.50
200	400	-0.470	-1.49	0.15	0.242	0.224	13.64	7.27
200	600	-0.604	-1.56	0.22	0.326	0.312	19.54	9.78
200	800	-0.760	-1.63	0.29	0.423	0.399	25.43	12.69
200	1000	-0.906	-1.70	0.36	0.514	0.487	31.32	15.42
200	1200	-1.064	-1.78	0.44	0.612	0.575	37.21	18.37
200	1400	-1.215	-1.85	0.51	0.707	0.663	43.11	21.20
200	1600	-1.487	-1.94	0.60	0.876	0.750	49.00	26.28
200	1800	-1.560	-2.03	0.69	0.921	0.838	54.89	27.64
200	2000	-1.702	-2.12	0.78	1.010	0.926	60.79	30.30
100	2100	-1.786	-2.19	0.85	1.062	0.970	63.73	31.87
50	2150						65.21	0.00

* Nominal yield stress

Table B.11. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Back to Back Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.75				Back to back; gr 5 bolts				
Dist to gauge (in) ... 9.38				Non-critical orientation				
Moment arm (in)16.75								
LOAD		Ch.#1 (mV)	Total		STRAIN		STRESS	
Appl	Total		Read	Defl	At Gauge (uin/in)		(ksi)	
			(in)	(in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	-0.170						
	DL	-0.287			0.048	0.048	1.86	1.44
0	0	-0.297	0.89	0.00	0.054	0.048	1.86	1.63
200	200	-0.438	0.83	0.06	0.142	0.136	7.84	4.26
200	400	-0.599	0.77	0.12	0.242	0.224	13.82	7.27
200	600	-0.736	0.70	0.19	0.328	0.311	19.80	9.83
200	800	-0.889	0.64	0.25	0.423	0.399	25.79	12.69
200	1000	-1.033	0.57	0.32	0.513	0.487	31.77	15.38
200	1200	-1.190	0.50	0.39	0.611	0.575	37.75	18.32
200	1400	-1.351	0.44	0.45	0.711	0.662	43.73	21.33
100	1500	-1.431	0.40	0.49	0.761	0.706	46.72	22.82
100	1600	-1.511	0.37	0.52	0.811	0.750	49.71	24.32
100	1700	-1.584	0.33	0.56	0.856	0.794	52.71	25.68
100	1800	-1.672	0.29	0.60	0.911	0.838	55.70	27.33
100	1900	-1.745	0.26	0.63	0.956	0.882	58.69	28.69
100	2000	-1.835	0.22	0.67	1.012	0.925	61.68	30.37
100	2100	-1.916	0.18	0.71	1.063	0.969	64.67	31.89
100	2200	-2.000	0.13	0.76	1.115	1.013	67.66	33.46
100	2300	-2.095	0.08	0.81	1.174	1.057	70.65	35.23
100	2400	-2.190	-0.01	0.90	1.234	1.101	73.64	37.01
100	2500	-2.293	-0.11	1.00	1.298	1.145	76.63	38.93
100	2600	-2.392	-0.24	1.12	1.348	1.189	79.63	40.43
80	2680						82.02	

* Nominal yield stress

Table B.12. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Nested Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.88				Nested; gr 5 bolts				
Dist to gauge (in) ... 9.44				Non-critical orientation				
Moment arm (in)16.88								
LOAD		Ch.#1 (mV)	Total		STRAIN		STRESS	
Appl	Total		Read	Defl	At Gauge (uin/in)		(ksi)	
			(in)	(in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	-0.175						
	DL	-0.022			-0.048	-0.048	1.86	-1.44
0	0	-0.022	1.55	0.00	-0.048	-0.048	1.86	-1.44
200	200	0.125	1.46	0.09	-0.140	-0.137	7.89	-4.19
200	400	0.279	1.40	0.16	-0.236	-0.225	13.91	-7.07
200	600	0.438	1.32	0.23	-0.335	-0.314	19.94	-10.04
200	800	0.612	1.25	0.31	-0.443	-0.402	25.97	-13.29
200	1000	0.758	1.18	0.38	-0.534	-0.491	32.00	-16.02
200	1200	0.919	1.11	0.44	-0.634	-0.579	38.03	-19.03
200	1400	1.079	1.04	0.51	-0.734	-0.668	44.06	-22.02
200	1600	1.244	0.97	0.58	-0.837	-0.757	50.09	-25.10
100	1700	1.323	0.93	0.62	-0.886	-0.801	53.10	-26.58
100	1800	1.459	0.89	0.66	-0.971	-0.845	56.11	-29.12
100	1900	1.596	0.85	0.71	-1.056	-0.889	59.13	-31.68
100	2000	1.576	0.80	0.75	-1.044	-0.934	62.14	-31.31
100	2100	1.711	0.75	0.80	-1.128	-0.978	65.16	-33.83
100	2200	1.847	0.66	0.89	-1.212	-1.022	68.17	-36.37
100	2300	1.930	0.60	0.96	-1.264	-1.067	71.19	-37.93
100	2400	1.962	0.52	1.04	-1.284	-1.111	74.20	-38.52
100	2500	2.083	0.42	1.14	-1.360	-1.155	77.21	-40.79
100	2600	2.164	0.29	1.26	-1.410	-1.199	80.23	-42.30
100	2700	2.286	0.17	1.38	-1.486	-1.244	83.24	-44.58
74	2774						85.47	

* Nominal yield stress

Table B.13. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Nested Splice in Non-critical Configuration; Assembled Backwards (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.63				Nested; gr 5 bolts				
Dist to gauge (in) ... 9.06				Non-critical (backwards)				
Moment arm (in)16.63								
LOAD		Ch.#1	Total		STRAIN		STRESS	
Appl	Total		Read	Defl	At Gauge		(ksi)	
		(mV)	(in)	(in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	-0.168						
	DL	-0.239			0.049	0.049	1.86	1.48
0	0	-0.212	0.46	0.00	0.032	0.049	1.86	0.97
200	200	-0.381	0.39	0.07	0.138	0.139	7.80	4.16
200	400	-0.535	0.34	0.13	0.234	0.229	13.74	6.86
200	600	-0.667	0.28	0.18	0.316	0.319	19.68	9.57
200	800	-0.832	0.21	0.25	0.419	0.409	25.61	12.27
200	1000	-0.980	0.15	0.31	0.511	0.499	31.55	14.97
200	1200	-1.133	0.09	0.37	0.606	0.589	37.49	17.68
200	1400	-1.296	0.02	0.44	0.708	0.679	43.43	20.38
200	1600	-1.451	-0.04	0.50	0.804	0.769	49.37	23.08
200	1800	-1.618	-0.11	0.57	0.908	0.860	55.31	25.79
200	2000	-1.784	-0.19	0.65	1.012	0.950	61.25	28.49
100	2100	-1.862	-0.23	0.69	1.060	0.995	64.22	29.84
100	2200	-1.942	-0.27	0.73	1.110	1.040	67.19	31.20
100	2300	-2.029	-0.33	0.79	1.164	1.085	70.16	32.55
100	2400	-2.107	-0.39	0.85	1.213	1.130	73.13	33.90
100	2500	-2.198	-0.46	0.92	1.270	1.175	76.10	35.25
100	2600	-2.298	-0.54	1.00	1.332	1.220	79.07	36.60
100	2700	-2.382	-0.64	1.10	1.384	1.265	82.04	37.95
100	2800	-2.463	-0.74	1.20	1.435	1.310	85.01	39.31
73	2873						87.18	

* Nominal yield stress

Table B.14. Results of 17 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Face to Face Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in) .. 1.50				Face to face; gr 5 bolts				
Dist to gauge (in) ... 9.13				Non-critical orientation				
Moment arm (in)16.50								
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	-0.105						
	DL	0.064			-0.048	-0.048	1.86	-1.44
0	0	0.074	2.36	0.00	-0.054	-0.048	1.86	-1.63
200	200	0.202	2.31	0.05	-0.134	-0.136	7.75	-4.02
200	400	0.351	2.25	0.11	-0.227	-0.224	13.64	-6.80
200	600	0.512	2.19	0.17	-0.327	-0.312	19.54	-9.81
200	800	0.653	2.13	0.23	-0.415	-0.399	25.43	-12.45
200	1000	0.812	2.07	0.29	-0.514	-0.487	31.32	-15.42
200	1200	0.972	2.01	0.36	-0.614	-0.575	37.21	-18.41
200	1400	1.132	1.95	0.42	-0.713	-0.663	43.11	-21.40
200	1600	1.288	1.88	0.49	-0.811	-0.750	49.00	-24.32
200	1800	1.451	1.81	0.55	-0.912	-0.838	54.89	-27.36
200	2000	1.621	1.72	0.64	-1.018	-0.926	60.79	-30.54
100	2100	1.702	1.67	0.69	-1.069	-0.970	63.73	-32.06
100	2200	1.793	1.61	0.75	-1.125	-1.014	66.68	-33.76
100	2300	1.889	1.54	0.83	-1.185	-1.057	69.63	-35.55
100	2400	1.982	1.44	0.92	-1.243	-1.101	72.57	-37.29
100	2500	2.086	1.34	1.03	-1.308	-1.145	75.52	-39.23
100	2600	2.187	1.24	1.13	-1.371	-1.189	78.46	-41.12
100	2700	2.312	1.11	1.25	-1.449	-1.233	81.41	-43.46

* Nominal yield stress

- Bolt did not break-lateral translation of 18"

Table B.15. Results of 17 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				Marion 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.38				Back to back; gr 5 bolts				
Dist to gauge (in) ... 9.00				Critical orientation				
Moment arm (in)17.38								
LOAD		Ch.#1	Total		STRAIN		STRESS	
Appl	Total		Read	Defl	At Gauge		(ksi)	
		(mV)	(in)	(in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	1.016						
	DL	1.130			0.041	0.041	1.90	1.23
0	0	1.134	-1.09	0.00	0.043	0.041	1.90	1.30
200	200	1.332	-1.16	0.07	0.167	0.152	10.36	5.01
200	400	1.527	-1.22	0.14	0.288	0.263	18.81	8.65
200	600	1.718	-1.29	0.20	0.407	0.374	27.27	12.22
200	800	1.909	-1.37	0.28	0.526	0.485	35.73	15.79
200	1000	2.094	-1.43	0.35	0.642	0.596	44.19	19.25
200	1200	2.299	-1.54	0.45	0.769	0.707	52.64	23.08
200	1400	2.482	-1.63	0.54	0.883	0.818	61.10	26.50
200	1600	2.693	-1.73	0.64	1.015	0.929	69.56	30.44
100	1700	2.892	-1.79	0.70	1.139	0.985	73.79	34.16
100	1800	2.892	-1.95	0.87			78.01	

* Nominal yield stress

Table B.16. Results of 17 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

					BENDING TEST			
Splice length (in) ... 4.00					Marion 3 lb/ft - 80 ksi *			
Dist to bolt A (in) .. 1.96					Nested; gr 5 bolts			
Dist to gauge (in) ... 9.25					Critical orientation			
Moment arm (in)16.96								
LOAD		Ch.#1	Total		STRAIN		STRESS	
Appl	Total		Read	Defl	At Gauge	(ksi)	Obs @	
		(mV)	(in)	(in)	Obs.	Calc.	Base	Gauge
floor		0.944						
DL		0.880			0.040	0.040	1.90	1.20
0	0	0.865	-0.31	0.00	0.049	0.040	1.90	1.48
200	200	0.705	-0.39	0.08	0.149	0.142	10.15	4.27
200	400	0.538	-0.46	0.15	0.253	0.245	18.40	7.34
200	600	0.391	-0.53	0.22	0.345	0.347	26.66	10.41
200	800	0.223	-0.61	0.29	0.449	0.449	34.91	13.47
200	1000	0.058	-0.68	0.37	0.552	0.551	43.16	16.54
200	1200	-0.120	-0.76	0.45	0.663	0.653	51.42	19.60
200	1400	-0.297	-0.84	0.53	0.773	0.756	59.67	22.67
200	1600	-0.470	-0.93	0.61	0.881	0.858	67.92	25.73
200	1800	-0.650	-1.02	0.71	0.993	0.960	76.18	28.80
200	2000	-0.831	-1.15	0.84	1.106	1.062	84.43	31.87
100	2100	-0.928	-1.23	0.92	1.166	1.113	88.56	33.40
50	2150	-0.967	-1.37	1.05	1.191	1.139	90.62	34.16
49	2199						92.64	

* Nominal yield stress

Table B.17. Results of 17 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00			Marion 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.88			Face to face; gr 5 bolts					
Dist to gauge (in) ... 9.38			Critical orientation					
Moment arm (in)16.88								
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	1.152						
	DL	1.067			0.040	0.040	1.90	1.20
0	0	0.997	-1.52	0.00	0.084	0.040	1.90	2.51
200	200	0.894	-1.60	0.08	0.148	0.140	10.11	4.43
200	400	0.725	-1.68	0.16	0.253	0.239	18.33	7.59
200	600	0.572	-1.76	0.24	0.348	0.338	26.54	10.45
200	800	0.409	-1.84	0.32	0.450	0.438	34.75	13.50
200	1000	0.231	-1.93	0.41	0.561	0.537	42.97	16.83
200	1200	0.053	-2.02	0.50	0.672	0.637	51.18	20.15
200	1400	-0.128	-2.10	0.58	0.785	0.736	59.40	23.54
200	1600	-0.302	-2.21	0.69	0.893	0.835	67.61	26.79
150	1750	-0.442	-2.31	0.79	0.980	0.910	73.77	29.41
206	1956	-0.616	-2.43	0.91	1.089	1.012	82.23	32.66

* Nominal yield stress

Table B.18. Results of 17 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				Marion 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.19				Back to back; gr 5 bolts				
Dist to gauge (in) ... 9.13				Non-critical orientation				
Moment arm (in)16.19								
LOAD (lbs)		Ch.#1 (mV)	Total		STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total		Read (in)	Defl (in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	1.002						
	DL	0.928			0.040	0.040	1.90	1.20
0	0	1.006	0.96	0.00	-0.009	0.040	1.90	-0.26
200	200	0.833	0.90	0.07	0.099	0.134	9.78	2.98
200	400	0.672	0.84	0.13	0.200	0.228	17.65	5.99
200	600	0.419	0.77	0.19	0.357	0.321	25.53	10.71
200	800	0.334	0.71	0.26	0.410	0.415	33.41	12.30
200	1000	0.162	0.65	0.32	0.517	0.508	41.29	15.52
200	1200	-0.005	0.58	0.38	0.621	0.602	49.17	18.64
200	1400	-0.181	0.50	0.46	0.731	0.695	57.05	21.93
200	1600	-0.372	0.43	0.54	0.850	0.789	64.92	25.50
200	1800	-0.548	0.35	0.62	0.960	0.883	72.80	28.79
200	2000	-0.727	0.23	0.73	1.071	0.976	80.68	32.13
100	2100	-0.815	0.17	0.79	1.126	1.023	84.62	33.78
100	2200	-0.909	0.09	0.88	1.185	1.070	88.56	35.54
100	2300	-0.990	0.02	0.94	1.235	1.117	92.50	37.05
90	2390	-1.076	-0.07	1.03	1.289	1.159	96.04	38.66
80	2470	-1.145	-0.16	1.12	1.332	1.196	99.20	39.95
130	2600	-1.240	-0.31	1.27	1.391	1.257	104.32	41.72
83	2683						107.59	

* Nominal yield stress

Table B.19. Results of 17 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 4.00					Marion 3 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.50					Nested; gr 5 bolts				
Dist to gauge (in) ... 8.94					Non-critical orientation				
Moment arm (in)17.50									
LOAD (lbs)		Ch.#1 (mV)	Read (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)		
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge	
	floor	1.161							
	DL	1.226			0.041	0.041	1.90	1.23	
0	0	1.216	1.40	0.00	0.035	0.041	1.90	1.04	
200	200	1.419	1.32	0.09	0.161	0.154	10.41	4.84	
200	400	1.592	1.24	0.17	0.269	0.268	18.93	8.07	
200	600	1.808	1.15	0.26	0.404	0.381	27.45	12.11	
200	800	1.980	1.07	0.33	0.511	0.494	35.96	15.32	
200	1000	2.180	0.98	0.43	0.635	0.608	44.48	19.06	
200	1200	2.372	0.88	0.52	0.755	0.721	52.99	22.65	
200	1400	2.567	0.79	0.61	0.877	0.835	61.51	26.30	
200	1600	2.761	0.67	0.73	0.997	0.948	70.02	29.92	
230	1830	3.017	0.52	0.89	1.157	1.079	79.82	34.71	
220	2050	3.246	0.38	1.02	1.300	1.204	89.19	38.99	
140	2190	3.388	0.27	1.14	1.388	1.283	95.15	41.64	
160	2350	3.555	0.13	1.28	1.492	1.374	101.96	44.76	
125	2475	3.702	-0.03	1.44	1.584	1.445	107.28	47.51	
115	2590	3.856	-0.29	1.70	1.680	1.510	112.18	50.39	
102	2692						116.52		

* Nominal yield stress

Table B.20. Results of 17 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 4.00				Marion 3 lb/ft - 80 ksi *					
Dist to bolt A (in) .. 1.38				Face to face; gr 5 bolts					
Dist to gauge (in) ... 8.75				Non-critical orientation					
Moment arm (in)17.38									
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)		
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge	
floor		1.159							
DL		1.197			0.041	0.041	1.90	1.23	
0	0	1.199	2.57	0.00	0.042	0.041	1.90	1.27	
200	200	1.385	2.48	0.08	0.158	0.158	10.36	4.74	
200	400	1.563	2.40	0.17	0.269	0.275	18.81	8.07	
200	600	1.771	2.31	0.25	0.399	0.392	27.27	11.96	
200	800	1.954	2.23	0.34	0.513	0.508	35.73	15.38	
200	1000	2.152	2.13	0.43	0.636	0.625	44.19	19.08	
200	1200	2.352	2.05	0.52	0.761	0.742	52.64	22.82	
200	1400	2.462	1.95	0.61	0.829	0.859	61.10	24.87	
200	1600	2.727	1.87	0.70	0.994	0.976	69.56	29.83	
200	1800	2.963	1.76	0.81	1.141	1.093	78.01	34.24	
200	2000	3.159	1.62	0.94	1.263	1.210	86.47	37.90	
200	2200	3.372	1.45	1.12	1.396	1.327	94.93	41.88	
100	2300	3.461	1.34	1.22	1.452	1.385	99.16	43.55	
100	2400	3.565	1.20	1.37	1.516	1.444	103.39	45.49	

* Nominal yield stress

Table B.21. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

					BENDING TEST			
Splice length (in) ... 4.00					MARION 4 lb/ft - 80 ksi *			
Dist to bolt A (in) .. 1.56					Back to back; gr 5 bolts			
Dist to gauge (in) ...13.19					Critical orientation			
Moment arm (in)16.56								
LOAD (lbs)		Ch.#1 (mV)	Total		STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total		Read (in)	Defl (in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	1.259						
	DL	1.302			0.034	0.034	1.91	1.02
0	0	1.305	-1.01	0.00	0.036	0.034	1.91	1.08
200	200	1.418	-1.06	0.05	0.106	0.066	7.99	3.19
200	400	1.547	-1.10	0.09	0.187	0.097	14.06	5.60
200	600	1.658	-1.14	0.13	0.256	0.129	20.14	7.67
200	800	1.774	-1.18	0.18	0.328	0.160	26.22	9.84
200	1000	1.898	-1.23	0.22	0.405	0.192	32.29	12.16
200	1200	2.018	-1.27	0.26	0.480	0.224	38.37	14.40
200	1400	2.145	-1.32	0.31	0.559	0.255	44.45	16.78
200	1600	2.271	-1.37	0.36	0.638	0.287	50.53	19.13
200	1800	2.387	-1.44	0.43	0.710	0.319	56.60	21.30
200	2000	2.515	-1.57	0.56	0.790	0.279	62.68	23.69
21	2021						63.32	

* Nominal yield stress

Table B.22. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				MARION 4 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.56				Back to back; gr 9 bolts				
Dist to gauge (in) ...13.19				Critical orientation				
Moment arm (in)16.56								
LOAD		Ch.#1	Read	Total	STRAIN		STRESS	
Appl	Total				(mV)	(in)	(in)	At Gauge
					Obs.	Calc.	Base	Gauge
	floor	1.259						
	DL	1.287			0.034	0.034	1.91	1.02
0	0	1.297	-1.01	0.00	0.040	0.034	1.91	1.21
200	200	1.422	-1.06	0.05	0.118	0.066	7.99	3.54
200	400	1.536	-1.10	0.10	0.189	0.097	14.06	5.67
200	600	1.650	-1.15	0.14	0.260	0.129	20.14	7.81
200	800	1.770	-1.19	0.18	0.335	0.160	26.22	10.05
200	1000	1.898	-1.23	0.23	0.415	0.192	32.29	12.44
200	1200	2.009	-1.28	0.27	0.484	0.224	38.37	14.52
200	1400	2.126	-1.32	0.31	0.557	0.255	44.45	16.70
200	1600	2.261	-1.37	0.36	0.641	0.287	50.53	19.23
200	1800	2.387	-1.41	0.41	0.719	0.319	56.60	21.58
200	2000	2.507	-1.46	0.45	0.794	0.350	62.68	23.82
200	2200	2.635	-1.52	0.51	0.874	0.382	68.76	26.22
200	2400	2.765	-1.58	0.58	0.955	0.414	74.83	28.65
200	2600	2.890	-1.68	0.67	1.033	0.445	80.91	30.98
100	2700	2.939	-1.75	0.74	1.063	0.461	83.95	31.90
30	2730						84.86	

* Nominal yield stress

Table B.23. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 9 Field Bolts).

					BENDING TEST			
Splice length (in) ... 4.00					MARION 4 lb/ft - 80 ksi * Nested; gr 9 bolts Critical orientation			
Dist to bolt A (in) .. 1.63								
Dist to gauge (in) ... 9.31								
Moment arm (in)16.63								
LOAD (lbs)		Ch.#1 (mV)	Read (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	-0.343						
	DL	-0.388			0.038	0.038	1.91	1.14
0	0	-0.392	-0.10	0.00	0.040	0.038	1.91	1.21
200	200	-0.517	-0.14	0.04	0.118	0.107	8.01	3.55
200	400	-0.632	-0.18	0.09	0.190	0.175	14.11	5.70
200	600	-0.751	-0.23	0.13	0.264	0.244	20.22	7.93
200	800	-0.876	-0.27	0.18	0.342	0.313	26.32	10.26
200	1000	-1.004	-0.32	0.23	0.422	0.382	32.42	12.65
200	1200	-1.128	-0.37	0.27	0.499	0.450	38.53	14.97
200	1400	-1.260	-0.42	0.32	0.581	0.519	44.63	17.44
200	1600	-1.396	-0.47	0.37	0.666	0.588	50.73	19.98
200	1800	-1.503	-0.52	0.42	0.733	0.657	56.83	21.98
200	2000	-1.636	-0.57	0.47	0.816	0.725	62.94	24.47
200	2200	-1.764	-0.63	0.53	0.895	0.794	69.04	26.86
200	2400	-1.888	-0.70	0.60	0.973	0.863	75.14	29.18
200	2600	-2.020	-0.77	0.67	1.055	0.932	81.24	31.64
188	2788						86.98	

* Nominal yield stress

Table B.24. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Critical Configuration (Grade 8 Field Bolts).

BENDING TEST									
Splice length (in) ... 4.00					MARION 4 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.56					Face to face; gr 8 bolts				
Dist to gauge (in) ... 9.13					Critical orientation				
Moment arm (in)16.56									
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS		Obs @ Gauge
Appl	Total				(mV)	(in)	(in)	At Gauge (uin/in)	
					Obs.	Calc.			
	floor	1.267							
	DL	1.244			0.038	0.038	1.91	1.14	
0	0	1.227	-1.36	0.00	0.049	0.038	1.91	1.46	
200	200	1.102	-1.42	0.07	0.126	0.108	7.99	3.79	
200	400	0.982	-1.48	0.12	0.201	0.178	14.06	6.04	
200	600	0.865	-1.53	0.17	0.274	0.247	20.14	8.22	
200	800	0.744	-1.59	0.23	0.350	0.317	26.22	10.49	
200	1000	0.612	-1.65	0.29	0.432	0.387	32.29	12.95	
200	1200	0.489	-1.70	0.35	0.508	0.457	38.37	15.25	
200	1400	0.367	-1.76	0.40	0.584	0.527	44.45	17.53	
200	1600	0.241	-1.82	0.46	0.663	0.596	50.53	19.89	
200	1800	0.109	-1.89	0.53	0.745	0.666	56.60	22.36	
200	2000	-0.023	-1.95	0.60	0.827	0.736	62.68	24.82	
200	2200	-0.148	-2.04	0.69	0.905	0.806	68.76	27.16	
40	2240	-0.173	-2.14	0.78	0.921	0.820	69.97	27.63	
44	2284						71.31		

* Nominal yield stress

Table B.25. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				MARION 4 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.63				Back to back; gr 5 bolts				
Dist to gauge (in) ...13.19				Non-critical orientation				
Moment arm (in)16.63								
LOAD (lbs)		Ch.#1 (mV)	Read (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	1.272						
	DL	1.139			0.034	0.034	1.91	1.02
0	0	1.145	1.19	0.00	0.030	0.034	1.91	0.91
200	200	1.027	1.14	0.05	0.104	0.066	8.01	3.11
200	400	0.905	1.10	0.09	0.180	0.098	14.11	5.39
200	600	0.770	1.06	0.13	0.264	0.131	20.22	7.92
200	800	0.649	1.01	0.17	0.339	0.163	26.32	10.18
200	1000	0.521	0.97	0.22	0.419	0.195	32.42	12.57
200	1200	0.385	0.93	0.26	0.504	0.228	38.53	15.11
200	1400	0.269	0.88	0.31	0.576	0.260	44.63	17.28
200	1600	0.140	0.83	0.35	0.656	0.292	50.73	19.69
200	1800	0.012	0.79	0.40	0.736	0.325	56.83	22.09
200	2000	-0.126	0.74	0.45	0.822	0.357	62.94	24.67
200	2200	-0.254	0.68	0.50	0.902	0.389	69.04	27.06
200	2400	-0.380	0.62	0.56	0.980	0.421	75.14	29.41
200	2600	-0.510	0.55	0.64	1.061	0.454	81.24	31.84
100	2700	-0.579	0.48	0.71	1.104	0.470	84.30	33.13
59	2759						86.10	

* Nominal yield stress

Table B.26. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Non-critical Configuration (Grade 9 Field Bolts).

					BENDING TEST			
Splice length (in) ... 4.00					MARION 4 lb/ft - 80 ksi *			
Dist to bolt A (in) .. 1.63					Back to back; gr 9 bolts			
Dist to gauge (in) ...13.19					Non-critical orientation			
Moment arm (in)16.63								
LOAD		Ch.#1 (mV)	Total		STRAIN		STRESS	
Appl	Total		Read	Defl	At Gauge (uin/in)		(ksi)	
			(in)	(in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	1.272						
	DL	1.131			0.034	0.034	1.91	1.02
0	0	1.116	1.18	0.00	0.043	0.034	1.91	1.30
200	200	0.985	1.13	0.05	0.125	0.066	8.01	3.75
200	400	0.862	1.09	0.09	0.202	0.098	14.11	6.05
200	600	0.754	1.05	0.13	0.269	0.131	20.22	8.07
200	800	0.630	1.00	0.17	0.346	0.163	26.32	10.39
200	1000	0.500	0.96	0.22	0.427	0.195	32.42	12.81
200	1200	0.386	0.91	0.26	0.498	0.228	38.53	14.95
200	1400	0.246	0.87	0.31	0.585	0.260	44.63	17.56
200	1600	0.118	0.82	0.35	0.665	0.292	50.73	19.96
200	1800	-0.009	0.77	0.40	0.744	0.325	56.83	22.33
200	2000	-0.141	0.73	0.45	0.827	0.357	62.94	24.80
200	2200	-0.261	0.68	0.50	0.901	0.389	69.04	27.04
200	2400	-0.401	0.62	0.56	0.989	0.421	75.14	29.66
200	2600	-0.527	0.56	0.62	1.067	0.454	81.24	32.01
200	2800	-0.657	0.50	0.68	1.148	0.486	87.35	34.44
200	3000	-0.795	0.42	0.76	1.234	0.518	93.45	37.02
200	3200	-0.934	0.33	0.85	1.321	0.551	99.55	39.62
200	3400	-1.063	0.21	0.96	1.401	0.583	105.66	42.03
100	3500	-1.138	0.15	1.03	1.462	0.599	108.71	43.85
71	3571						110.87	

* Nominal yield stress

Table B.27. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Non-critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) ... 4.00					MARION 4 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.38					Nested; gr 5 bolts				
Dist to gauge (in) ... 9.00					Non-critical orientation				
Moment arm (in)16.38									
LOAD		Ch.#1	Total		STRAIN		STRESS		Obs @
Appl	Total		Read	Defl	At Gauge		(ksi)		
		(mV)	(in)	(in)	Obs.	Calc.	Base	Gauge	
	floor	-0.339							
	DL	-0.264			0.038	0.038	1.91	1.14	
0	0	-0.268	1.51	0.00	0.036	0.038	1.91	1.07	
200	200	-0.145	1.45	0.06	0.112	0.108	7.92	3.36	
200	400	-0.033	1.40	0.11	0.182	0.177	13.93	5.46	
200	600	0.089	1.35	0.16	0.258	0.246	19.94	7.74	
200	800	0.248	1.30	0.21	0.357	0.316	25.95	10.71	
200	1000	0.338	1.25	0.26	0.413	0.385	31.96	12.39	
200	1200	0.473	1.20	0.31	0.497	0.454	37.97	14.92	
200	1400	0.603	1.15	0.36	0.578	0.523	43.99	17.35	
200	1600	0.722	1.10	0.41	0.652	0.593	50.00	19.57	
200	1800	0.853	1.04	0.46	0.734	0.662	56.01	22.02	
200	2000	0.982	0.99	0.51	0.814	0.731	62.02	24.43	
200	2200	1.102	0.94	0.57	0.889	0.801	68.03	26.67	
200	2400	1.355	0.88	0.63	1.047	0.870	74.04	31.40	
200	2600	1.355	0.82	0.69	1.047	0.939	80.05	31.40	
200	2800	1.480	0.74	0.76	1.125	1.008	86.06	33.74	
117	2917						89.58		

* Nominal yield stress

Table B.28. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Non-critical Configuration (Grade 9 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				MARION 4 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.38				Nested; gr 9 bolts				
Dist to gauge (in) ... 9.00				Non-critical orientation				
Moment arm (in)16.38								
LOAD		Ch.#1 (mV)	Total		STRAIN		STRESS	
Appl	Total		Read (in)	Defl (in)	At Gauge (uin/in)		(ksi)	Obs @
					Obs.	Calc.	Base	Gauge
	floor	-0.339						
	DL	-0.268			0.038	0.038	1.91	1.14
0	0	-0.275	1.46	0.00	0.034	0.038	1.91	1.01
200	200	-0.148	1.41	0.06	0.113	0.108	7.92	3.38
200	400	-0.003	1.36	0.10	0.203	0.177	13.93	6.09
200	600	0.090	1.31	0.15	0.261	0.246	19.94	7.83
200	800	0.208	1.26	0.20	0.335	0.316	25.95	10.04
200	1000	0.334	1.21	0.25	0.413	0.385	31.96	12.39
200	1200	0.462	1.16	0.30	0.493	0.454	37.97	14.79
200	1400	0.586	1.11	0.35	0.570	0.523	43.99	17.10
200	1600	0.711	1.06	0.40	0.648	0.593	50.00	19.44
200	1800	0.870	1.01	0.46	0.747	0.662	56.01	22.41
200	2000	0.996	0.95	0.51	0.826	0.731	62.02	24.77
200	2200	1.119	0.90	0.56	0.902	0.801	68.03	27.07
200	2400	1.243	0.84	0.62	0.979	0.870	74.04	29.38
200	2600	1.349	0.78	0.68	1.045	0.939	80.05	31.36
200	2800	1.476	0.72	0.74	1.125	1.008	86.06	33.74
200	3000	1.598	0.66	0.80	1.201	1.078	92.07	32.33
200	3200	1.731	0.59	0.87	1.283	1.147	98.08	34.41
150	3350	1.840	0.53	0.93	1.351	1.199	102.59	35.97
150	3500	1.942	0.46	1.01	1.415	1.251	107.10	37.53
100	3600	1.988	0.40	1.06	1.444	1.286	110.11	38.57
100	3700	2.056	0.34	1.12	1.486	1.320	113.11	39.61
79	3779						115.49	

* Nominal yield stress

Table B.29. Results of 17 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Non-critical Configuration (Grade 8 Field Bolts).

BENDING TEST								
Splice length (in) ... 4.00				MARION 4 lb/ft - 80 ksi *				
Dist to bolt A (in) .. 1.63				Face to face; gr 8 bolts				
Dist to gauge (in) ... 9.25				Non-critical orientation				
Moment arm (in)16.63								
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	1.246						
	DL	1.258			0.038	0.038	1.91	1.14
0	0	1.211	2.85	0.00	0.009	0.038	1.91	0.26
200	200	1.015	2.80	0.05	-0.113	0.107	8.01	-3.40
200	400	1.117	2.75	0.10	-0.050	0.177	14.11	-1.50
200	600	1.220	2.70	0.15	0.014	0.246	20.22	0.43
200	800	1.278	2.64	0.21	0.050	0.315	26.32	1.51
200	1000	1.389	2.59	0.26	0.120	0.385	32.42	3.59
200	1200	1.511	2.54	0.31	0.196	0.454	38.53	5.87
200	1400	1.635	2.48	0.37	0.273	0.523	44.63	8.19
200	1600	1.758	2.43	0.42	0.350	0.592	50.73	10.49
200	1800	1.877	2.37	0.48	0.424	0.662	56.83	12.71
200	2000	2.012	2.31	0.54	0.508	0.731	62.94	15.23
200	2200	2.136	2.25	0.60	0.585	0.800	69.04	17.55
200	2400	2.264	2.19	0.66	0.665	0.870	75.14	19.94
200	2600	2.402	2.12	0.73	0.751	0.939	81.24	22.52
200	2800	2.532	2.04	0.81	0.832	1.008	87.35	24.95
200	3000	2.662	1.95	0.90	0.913	1.078	93.45	27.38
100	3100	2.727	1.91	0.94	0.953	1.112	96.50	28.60
75	3175	2.767	1.84	1.01	0.978	1.138	98.79	29.35
26	3201						99.58	

* Nominal yield stress

- Bolt did not break - post tip translated 18 in laterally

APPENDIX C

FINAL 71' BENDING TESTS

FIELD BOLT SUMMARY TABLES

Franklin 3 & 4 lb/ft Posts - 60 ksi Nominal Yield Stress

Marion 3 & 4 lb/ft Posts - 80 ksi Nominal Yield Stress

Back to Back and Nested Splices

Critical Configuration

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Table C.1. Results of 71 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) 3.00				FRANKLIN 3 lb/ft - 60 ksi *				
Dist to bolt A (in) 1.56				Back to back; gr 5 bolts				
Dist to strain gauge (in) 7.56				Critical orientation				
Moment arm (in)71.38								
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS	
(lbs)	Appl Total				(mV)	(in)	(in)	At Gauge (uin/in)
					Obs.	Calc.	Base	Gauge
floor		0.317						
tight		0.333						
DL		0.456	0.00	0.00	-0.053	-0.053	1.93	-1.59
60	60	0.986	0.94	0.94	-0.383	-0.368	12.50	-11.50
32	92	1.286	0.51	1.45	-0.570	-0.536	18.14	-17.10
32	124	1.559	0.51	1.96	-0.740	-0.704	23.78	-22.21
32	156	1.843	0.54	2.50	-0.917	-0.872	29.42	-27.51
32	188	2.119	0.54	3.04	-1.089	-1.040	35.06	-32.67
32	220	2.389	0.55	3.59	-1.257	-1.208	40.70	-37.72
32	252	2.638	0.52	4.11	-1.412	-1.376	46.34	-42.37
32	284	2.883	0.54	4.65	-1.565	-1.544	51.98	-46.95
32	316	3.141	0.60	5.24	-1.726	-1.712	57.62	-51.78
32	348	3.369	0.62	5.86	-1.868	-1.880	63.26	-56.04
32	380	3.589	0.71	6.57	-2.005	-2.048	68.90	-60.15
16	396	3.608	0.42	6.98	-2.017	-2.132	71.72	-60.50
16	412	3.711	0.46	7.44	-2.081	-2.216	74.53	-62.43
16	428	3.796	0.59	8.03	-2.134	-2.300	77.35	-64.02

* Nominal yield stress

Table C.2. Results of 71 Inch Bending Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) 3.00				FRANKLIN 3 lb/ft - 60 ksi *				
Dist to bolt A (in) 1.63				Nested; gr 5 bolts				
Dist to strain gauge (in) 7.69				Critical orientation				
Moment arm (in) 71.56								
LOAD		Ch. #1	Tip	Total	STRAIN		STRESS	
(lbs)					Defl	Defl	At Gauge	(ksi)
Appl	Total	(mV)	(in)	(in)	Obs.	Calc.	Base	Gauge
	floor	0.249						
	tight	0.415						
	DL	0.380	0.00	0.00	0.052	0.052	1.93	1.55
60	60	-0.158	1.35	1.35	0.387	0.368	12.53	11.61
32	92	-0.445	0.60	1.95	0.566	0.536	18.18	16.97
32	124	-0.710	0.53	2.48	0.731	0.704	23.84	21.93
32	156	-1.004	0.62	3.10	0.914	0.872	29.49	27.42
32	188	-1.265	0.58	3.67	1.077	1.041	35.14	32.30
32	220	-1.539	0.62	4.29	1.247	1.209	40.80	37.42
32	252	-1.809	0.63	4.91	1.416	1.377	46.45	42.47
32	284	-2.094	0.71	5.62	1.593	1.545	52.11	47.79
32	316	-2.399	0.92	6.54	1.783	1.713	57.76	53.50
16	332	-2.540	0.48	7.01	1.871	1.798	60.59	56.13
16	348	-2.699	0.58	7.59	1.970	1.882	63.41	59.10
16	364	-2.829	0.55	8.13	2.051	1.966	66.24	61.53
16	380	-2.963	0.81	8.94	2.135	2.050	69.07	64.04

* Nominal yield stress

Table C.3. Results of 71 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in)			4.00		FRANKLIN 4 lb/ft - 60 ksi *				
Dist to bolt A (in)			1.44		Back to back; gr 5 bolts				
Dist to strain gauge (in)			9.25		Critical orientation				
Moment arm (in)			71.50						
LOAD		Ch. #1	Tip Defl	Total Defl	STRAIN		STRESS		
(lbs)	Appl				At Gauge	(ksi)	Obs @		
		(mV)	(in)	(in)	(uin/in)	Base	Gauge		
					Obs.	Calc.			
floor		-1.412							
tight		-1.410			0.000				
	DL	-1.015	0.00	0.00	-0.036	-0.036	1.39	-1.08	
60	60	-0.665	0.71	0.71	-0.254	-0.259	9.05	-7.63	
32	92	-0.473	0.41	1.12	-0.374	-0.377	13.14	-11.21	
32	124	-0.274	0.41	1.53	-0.498	-0.496	17.23	-14.93	
32	156	-0.077	0.41	1.93	-0.621	-0.614	21.31	-18.62	
32	188	0.108	0.40	2.33	-0.736	-0.733	25.40	-22.07	
32	220	0.314	0.43	2.76	-0.864	-0.851	29.48	-25.93	
32	252	0.512	0.42	3.18	-0.988	-0.970	33.57	-29.63	
32	284	0.703	0.42	3.60	-1.107	-1.089	37.65	-33.20	
32	316	0.915	0.45	4.05	-1.239	-1.207	41.74	-37.16	
32	348	1.091	0.42	4.47	-1.348	-1.326	45.83	-40.45	
32	380	1.291	0.42	4.89	-1.473	-1.444	49.91	-44.19	
32	412	1.500	0.51	5.39	-1.603	-1.563	54.00	-48.09	
16	428		0.28	5.67		-1.622	56.04		

* Nominal yield stress

Table C.4. Results of 71 Inch Bending Test: Franklin 4 lb/ft - 60 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in)			4.00		FRANKLIN 4 lb/ft - 60 ksi *			
Dist to bolt A (in)			1.50		Nested; gr 5 bolts			
Dist to strain gauge (in)			8.94		Critical orientation			
Moment arm (in)			71.56					
					STRAIN		STRESS	
LOAD		Ch.#1	Tip	Total	At Gauge		(ksi)	
(lbs)					Defl	Defl	(uin/in)	
Appl	Total	(mV)	(in)	(in)	Obs.	Calc.	Base	Gauge
	floor	-1.216						
	tight	-1.147			0.000			
	DL	-1.311	0.00	0.00	0.037	0.037	1.39	1.10
60	60	-1.662	0.68	0.68	0.255	0.260	9.06	7.66
32	92	-1.851	0.39	1.06	0.373	0.379	13.15	11.20
32	124	-2.036	0.37	1.43	0.488	0.499	17.24	14.65
32	156	-2.225	0.38	1.81	0.606	0.618	21.33	18.19
32	188	-2.417	0.38	2.19	0.726	0.737	25.42	21.78
32	220	-2.618	0.41	2.60	0.851	0.857	29.51	25.53
32	252	-2.799	0.37	2.97	0.964	0.976	33.60	28.92
32	284	-2.989	0.39	3.35	1.082	1.095	37.68	32.47
32	316	-3.198	0.43	3.78	1.212	1.214	41.77	36.37
32	348	-3.402	0.43	4.21	1.340	1.334	45.86	40.19
32	380	-3.598	0.42	4.63	1.462	1.453	49.95	43.85
32	412	-3.827	0.51	5.14	1.604	1.572	54.04	48.13
32	444	-4.083	0.59	5.73	1.764	1.691	58.13	52.92
16	460	-4.216	0.35	6.08	1.847	1.751	60.17	55.40

* Nominal yield stress

Table C.5. Results of 71 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in) 3.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) 1.38				Back to back; gr 5 bolts				
Dist to strain gauge (in) 7.88				Critical orientation				
Moment arm (in) 72.38								
LOAD		Ch.#1	Tip	Total	STRAIN		STRESS	
(lbs)	(mV)				Defl	Defl	At Gauge	(ksi)
Appl	Total		(in)	(in)	Obs.	Calc.	Base	Gauge
	floor	**						
	tight	**						
	DL	8.242	0.00	0.00	0.042	0.042	1.90	1.26
60	60	7.848	0.74	0.74	0.287	0.298	12.46	8.62
32	92	7.661	0.38	1.11	0.404	0.435	18.10	12.12
32	124	7.471	0.39	1.50	0.522	0.572	23.73	15.67
32	156	7.266	0.41	1.91	0.650	0.709	29.37	19.50
32	188	7.068	0.43	2.34	0.773	0.845	35.00	23.20
32	220	6.878	0.46	2.79	0.892	0.982	40.64	26.75
32	252	6.653	0.55	3.34	1.032	1.119	46.27	30.96
32	284	6.446	0.50	3.84	1.161	1.256	51.91	34.83
32	316	6.252	0.51	4.34	1.282	1.393	57.54	38.45
32	348	6.052	0.67	5.01	1.406	1.529	63.18	42.19
16	364	5.980	0.66	5.66	1.451	1.598	66.00	43.54

* Nominal yield stress

** Strain gauge malfunction - data omitted

Table C.6. Results of 71 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TEST								
Splice length (in) 3.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) 1.63				Back to back; gr 9 bolts				
Dist to strain gauge (in) 8.13				Critical orientation				
Moment arm (in) 71.38								
LOAD		Ch.#1	Tip Defl	Total Defl	STRAIN		STRESS	
Appl	Total				(mV)	(in)	(in)	At Gauge (uin/in)
			(in)	(in)	Obs.	Calc.	Base	
floor		2.253						
tight		2.233						
	DL	2.372	0.00	0.00	0.042	0.042	1.90	1.25
60	60	2.801	0.82	0.82	0.309	0.293	12.32	9.27
32	92	3.017	0.41	1.22	0.443	0.427	17.88	13.30
32	124	3.250	0.47	1.69	0.589	0.561	23.43	17.66
32	156	3.474	0.47	2.16	0.728	0.695	28.99	21.85
32	188	3.697	0.51	2.67	0.867	0.830	34.55	26.01
32	220	3.917	0.50	3.17	1.004	0.964	40.11	30.13
32	252	4.125	0.52	3.69	1.134	1.098	45.66	34.01
32	284	4.318	0.51	4.20	1.254	1.232	51.22	37.62
32	316	4.158	0.56	4.75	1.154	1.366	56.78	34.63
32	348	4.709	0.60	5.35	1.498	1.500	62.34	44.93
32	380	4.935	0.76	6.10	1.639	1.634	67.89	49.16
32	412	5.140	0.70	6.80	1.766	1.769	73.45	52.99
32	444	5.348	0.79	7.59	1.896	1.903	79.01	56.87
16	460	5.496	0.62	8.21	1.988	1.970	81.79	59.64
16	476	5.617	0.46	8.67	2.063	2.037	84.57	61.90
16	492	5.739	0.57	9.24	2.139	2.104	87.35	64.18

* Nominal yield stress

Table C.7. Results of 71 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in)			3.00		MARION 3 lb/ft - 80 ksi *			
Dist to bolt A (in)			1.50		Nested; gr 5 bolts			
Dist to strain gauge (in)			7.75		Critical orientation			
Moment arm (in)			72.06					
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN (uin/in)		STRESS (ksi)	
Appl	Total				Obs.	Calc.	Base	Obs @ Gauge
	floor	4.797						
	tight	4.112						
	DL	**	0.00	0.00	**	0.042	1.90	**
60	60	**	0.90	0.90	**	0.298	12.42	**
32	92	4.952	0.50	1.39	0.434	0.434	18.03	13.02
32	124	5.188	0.51	1.90	0.581	0.571	23.64	17.43
32	156	5.415	0.50	2.40	0.722	0.707	29.25	21.67
32	188	5.634	0.49	2.89	0.859	0.843	34.86	25.77
32	220	5.866	0.54	3.43	1.003	0.980	40.47	30.10
32	252	6.078	0.52	3.95	1.136	1.116	46.08	34.07
48	300	6.415	0.93	4.88	1.346	1.321	54.50	40.37
16	316	6.525	0.33	5.21	1.414	1.389	57.30	42.42
16	332	6.647	0.48	5.69	1.490	1.457	60.11	44.70
16	348	6.756	0.50	6.19	1.558	1.525	62.91	46.74
16	364	6.878	0.59	6.78	1.634	1.593	65.72	49.02

* Nominal yield stress

** Strain gauge malfunction - data omitted

Table C.8. Results of 71 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TEST								
Splice length (in) 3.00				MARION 3 lb/ft - 80 ksi *				
Dist to bolt A (in) 1.44				Nested; gr 9 bolts				
Dist to strain gauge (in) 10.06				Critical orientation				
Moment arm (in) 71.44								
LOAD		Ch. #1	Tip Defl	Total Defl	STRAIN		STRESS	
(lbs)					(in)	(in)	At Gauge (uin/in)	(ksi)
Appl	Total	(mV)			Obs.	Calc.	Base	Gauge
	floor	1.800						
	tight	1.811						
	DL	1.726	0.00	0.00	0.039	0.039	1.90	1.18
60	60	1.339	0.92	0.92	0.280	0.283	12.33	8.41
32	92	1.135	0.51	1.43	0.408	0.414	17.89	12.23
32	124	0.922	0.52	1.95	0.540	0.544	23.45	16.21
32	156	0.717	0.52	2.47	0.668	0.674	29.01	20.04
32	188	0.492	0.57	3.03	0.808	0.804	34.58	24.25
32	220	0.285	0.53	3.56	0.937	0.934	40.14	28.12
32	252	0.081	0.53	4.09	1.064	1.064	45.70	31.93
32	284	-0.107	0.52	4.61	1.181	1.195	51.26	35.44
32	316	-0.306	0.59	5.20	1.305	1.325	56.83	39.16
32	348	-0.516	0.80	6.00	1.436	1.455	62.39	43.09
32	380	-0.709	0.80	6.80	1.557	1.585	67.95	46.70
32	412	-0.837	0.60	7.39	1.636	1.715	73.51	49.09
32	444	-1.006	0.92	8.31	1.742	1.845	79.07	52.25
16	460	-1.129	0.60	8.91	1.818	1.910	81.86	54.55
16	476	-1.200	0.48	9.38	1.862	1.976	84.64	55.87
16	492	-1.368	1.13	10.51	1.967	2.041	87.42	59.01

* Nominal yield stress

Table C.9. Results of 71 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST									
Splice length (in) 4.00				MARION 4 lb/ft - 80 ksi *					
Dist to bolt A (in) 1.44				Back to back; gr 5 bolts					
Dist to strain gauge (in) 8.88				Critical orientation					
Moment arm (in) 71.25									
LOAD		Ch.#1	Tip	Total	STRAIN		STRESS		Obs @
(lbs)	Appl Total				(mV)	Defl	Defl	At Gauge	
			(in)	(in)	Obs.	Calc.			
floor		-0.430							
tight		-0.426							
	DL	-0.319	0.00	0.00	0.038	0.038	1.91	1.14	
60	60	-0.022	0.53	0.53	0.223	0.214	9.75	6.69	
32	92	0.156	0.32	0.85	0.334	0.308	13.94	10.02	
32	124	0.299	0.25	1.10	0.423	0.402	18.12	12.69	
32	156	0.459	0.29	1.38	0.523	0.495	22.30	15.68	
32	188	0.635	0.31	1.69	0.632	0.589	26.49	18.97	
32	220	0.793	0.29	1.98	0.731	0.683	30.67	21.93	
32	252	0.965	0.31	2.29	0.838	0.776	34.85	25.14	
32	284	1.125	0.30	2.58	0.938	0.870	39.04	28.13	
32	316	1.295	0.31	2.89	1.044	0.964	43.22	31.31	
32	348	1.468	0.33	3.22	1.151	1.057	47.40	34.54	
32	380	1.633	0.34	3.55	1.254	1.151	51.59	37.63	
32	412	1.801	0.34	3.89	1.359	1.245	55.77	40.77	
16	428		0.34	4.22		1.292	57.79		

* Nominal yield stress

Table C.10. Results of 71 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TEST								
Splice length (in)			4.00		MARION 4 lb/ft - 80 ksi *			
Dist to bolt A (in)			1.44		Back to back; gr 9 bolts			
Dist to strain gauge (in)			8.88		Critical orientation			
Moment arm (in)			71.25					
Appl. load (lbs)	Total Load (lbs)	Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
					Obs.	Calc.	Base	Obs @ Gauge
	floor tight	-0.430						
	DL	-0.426						
	DL	-0.337	0.00	0.00	0.038	0.038	1.91	1.15
60	60	-0.028	0.56	0.56	0.231	0.214	9.75	6.93
32	92	0.132	0.29	0.85	0.331	0.308	13.94	9.92
32	124	0.296	0.30	1.15	0.433	0.402	18.12	12.99
32	156	0.458	0.30	1.45	0.534	0.495	22.30	16.01
32	188	0.628	0.32	1.77	0.640	0.589	26.49	19.19
32	220	0.797	0.31	2.08	0.745	0.683	30.67	22.35
32	252	0.960	0.31	2.38	0.847	0.776	34.85	25.40
32	284	1.120	0.30	2.68	0.946	0.870	39.04	28.39
32	316	1.279	0.30	2.98	1.045	0.964	43.22	31.36
32	348	1.444	0.32	3.29	1.148	1.057	47.40	34.44
32	380	1.604	0.31	3.60	1.248	1.151	51.59	37.43
32	412	1.767	0.33	3.93	1.349	1.245	55.77	40.48
32	444	1.926	0.34	4.27	1.448	1.339	59.95	43.45
32	476	2.071	0.33	4.59	1.539	1.432	64.14	46.16
32	508	2.244	0.40	4.99	1.647	1.526	68.32	49.40
32	540	2.398	0.38	5.37	1.743	1.620	72.50	52.28
32	572	2.568	0.49	5.85	1.848	1.713	76.69	55.45
16	588	2.635	0.24	6.09	1.890	1.760	78.78	56.71

* Nominal yield stress

Table C.11. Results of 71 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TEST								
Splice length (in)			4.00		MARION 4 lb/ft - 80 ksi *			
Dist to bolt A (in)			1.75		Nested; gr 5 bolts			
Dist to strain gauge (in)			9.25		Critical orientation			
Moment arm (in)			71.75					
LOAD			Tip	Total	STRAIN		STRESS	
(lbs)	Ch.#1	Defl	Defl	At Gauge	(uin/in)		(ksi)	
Appl	Total	(mV)	(in)	(in)	Obs.	Calc.	Base	Obs @ Gauge
	floor	0.356						
	tight	0.384						
	DL	0.305	0.00	0.00	0.038	0.038	1.91	1.14
60	60	-0.015	0.61	0.61	0.237	0.214	9.81	7.12
32	92	-0.164	0.29	0.90	0.330	0.308	14.02	9.91
32	124	-0.326	0.32	1.21	0.431	0.402	18.23	12.94
32	156	-0.488	0.33	1.54	0.532	0.496	22.45	15.96
32	188	-0.653	0.33	1.87	0.635	0.590	26.66	19.05
32	220	-0.818	0.33	2.19	0.738	0.684	30.87	22.13
32	252	-0.973	0.31	2.50	0.834	0.778	35.08	25.03
32	284	-1.128	0.31	2.81	0.931	0.871	39.30	27.93
32	316	-1.283	0.31	3.12	1.027	0.965	43.51	30.82
32	348	-1.375	0.41	3.53	1.085	1.059	47.72	32.54
32	380	-1.596	0.23	3.76	1.222	1.153	51.94	36.67
32	412	-1.745	0.31	4.07	1.315	1.247	56.15	39.46
32	444	-1.903	0.32	4.39	1.414	1.341	60.36	42.41
32	476	-2.054	0.38	4.77	1.508	1.435	64.57	45.24

* Nominal yield stress

Table C.12. Results of 71 Inch Bending Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TEST								
Splice length (in) 4.00			MARION 4 lb/ft - 80 ksi *					
Dist to bolt A (in) 1.75			Nested; gr 9 bolts					
Dist to strain gauge (in) 9.25			Critical orientation					
Moment arm (in) 71.75								
Appl. load (lbs)	Total Load (lbs)	Ch.#1 (mV)	Tip Defl (in)	Total Defl (in)	STRAIN At Gauge (uin/in)		STRESS (ksi)	
					Obs.	Calc.	Base	Obs @ Gauge
	floor	0.356						
	tight	0.384						
	DL	0.304	0.00	0.00	0.038	0.038	1.91	1.14
60	60	-0.013	0.62	0.62	0.236	0.214	9.81	7.07
32	92	-0.165	0.30	0.91	0.330	0.308	14.02	9.91
32	124	-0.330	0.33	1.24	0.433	0.402	18.23	12.99
32	156	-0.491	0.32	1.56	0.533	0.496	22.45	16.00
32	188	-0.652	0.32	1.88	0.634	0.590	26.66	19.01
32	220	-0.815	0.33	2.21	0.735	0.684	30.87	22.06
32	252	-0.968	0.32	2.52	0.831	0.778	35.08	24.92
32	284	-1.126	0.32	2.84	0.929	0.871	39.30	27.87
32	316	-1.287	0.34	3.18	1.029	0.965	43.51	30.88
32	348	-1.444	0.32	3.49	1.127	1.059	47.72	33.81
32	380	-1.587	0.30	3.79	1.216	1.153	51.94	36.49
32	412	-1.743	0.32	4.11	1.313	1.247	56.15	39.40
32	444	-1.891	0.32	4.43	1.406	1.341	60.36	42.17
32	476	-2.04	0.33	4.76	1.495	1.435	64.57	44.86
32	508	-2.19	0.35	5.11	1.593	1.529	68.79	47.80
32	540	-2.34	0.35	5.46	1.687	1.623	73.00	50.60
32	572	-2.48	0.36	5.81	1.770	1.716	77.21	53.09
32	604	-2.63	0.52	6.34	1.866	1.810	81.43	55.98
16	620	-2.71	0.23	6.57	1.917	1.857	83.53	57.50

* Nominal yield stress

APPENDIX D

TORSION TESTS

FIELD AND CALIBRATED BOLT SUMMARY TABLES

Franklin 3 & 4 lb/ft Posts - 60 ksi Nominal Yield Stress

Marion 3 & 4 lb/ft Posts - 80 ksi Nominal Yield Stress

Back to Back and Nested Splices

& Post W/O Splice

APPENDIX D

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Table D.1. Results of Torsion Test: Franklin 3 lb/ft - 60 ksi Post;
Post W/O Splice.

TORSION TEST		
FRANKLIN 3 lb/ft		
60 (ksi) *		
NO SPLICE		
post length: 123 in		
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)
0	0.00	0.0
50	0.21	15.0
100	0.41	30.0
150	0.62	45.0
200	0.83	60.5
250	1.03	75.0
300	1.24	91.0
350	1.44	107.0
400	1.65	123.0
450	1.86	136.0
500	2.06	147.5
550	2.27	166.5
600	2.48	183.5
650	2.68	203.5
700	2.89	224.0
750	3.09	246.5
800	3.30	267.0
850	3.51	295.5
900	3.71	315.5
950	3.92	338.0
1000	4.13	362.0
750	3.09	315.0
500	2.06	252.0
250	1.03	179.5
0	0.00	92.0

* Nominal yield stress

Table D.2. Results of Torsion Test: Franklin 3 lb/ft - 60 ksi Post;
3 Inch Back to Back Splice (Calibrated and Grade 5 Field
Bolts).

TORSION TEST						
FRANKLIN 3 lb/ft - 60 ksi *					BOLT LOADS	
back to back; gr 5 bolts						
splice length: 3 in						
post length: 123 in						
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Bolt A Obs. (kips)	Bolt B Obs. (kips)
loose			0.421	0.065	0.00	0.00
tight			-1.740	-2.327	3.71	3.67
0	0.00	0.0	-1.710	-2.274	3.66	3.59
50	0.21	16.5	-1.724	-2.249	3.68	3.55
100	0.41	33.0	-1.748	-2.216	3.72	3.50
150	0.62	50.5	-1.780	-2.181	3.78	3.45
200	0.83	66.0	-1.818	-2.162	3.84	3.42
250	1.03	81.5	-1.860	-2.159	3.92	3.41
300	1.24	96.5	-1.192	-2.154	2.77	3.41
350	1.44	111.5	-1.964	-2.149	4.09	3.40
400	1.65	126.5	-2.024	-2.145	4.20	3.39
450	1.86	139.0	-2.071	-2.165	4.28	3.42
500	2.06	152.0	-2.121	-2.189	4.36	3.46
550	2.27	170.0	-2.175	-2.268	4.46	3.58
600	2.48	190.0	-2.199	-2.409	4.50	3.80
650	2.68	215.5	-2.204	-2.609	4.51	4.10
700	2.89	240.5	-2.169	-2.813	4.45	4.42
750	3.09	266.5	-2.092	-3.061	4.31	4.80
800	3.30	295.0	-2.008	-3.371	4.17	5.27
850	3.51	331.0	-1.904	**	3.99	**
900	3.71	371.5	-1.832		3.87	
500	2.06	284.0	-1.697		3.64	
250	1.03	221.5	-1.599		3.47	
0	0.00	125.0	-1.417		3.15	

* Nominal yield stress

** Bolt #7 not working properly - data omitted

Table D.3. Results of Torsion Test: Franklin 3 lb/ft - 60 ksi Post; 3 Inch Nested Splice (Calibrated and Grade 5 Field Bolts).

TORSION TEST						
FRANKLIN 3 lb/ft - 60 ksi *					BOLT LOADS	
nested; gr 5 bolts						
splice length: 3 in						
post length: 123 in						
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Bolt A Obs. (kips)	Bolt B Obs. (kips)
loose			**	0.434	**	0.00
tight				-1.336		3.04
0	0.00	0.0		-1.282		2.95
50	0.21	14.0		-1.283		2.95
100	0.41	29.5		-1.277		2.94
150	0.62	43.5		-1.278		2.94
200	0.83	58.4		-1.290		2.96
250	1.03	74.0		-1.294		2.97
300	1.24	89.5		-1.312		3.00
350	1.44	105.0		-1.351		3.06
400	1.65	122.5		-1.391		3.13
450	1.86	137.5		-1.414		3.17
500	2.06	149.0		-1.454		3.24
550	2.27	169.0		-1.504		3.33
600	2.48	191.5		-1.566		3.43
650	2.68	214.5		-1.628		3.54
700	2.89	236.0		-1.713		3.69
750	3.09	259.5		-1.785		3.81
800	3.30	285.0		-1.860		3.94
850	3.51	309.5		-1.918		4.04
900	3.71	337.0		-1.985		4.15
950	3.92	369.0		-2.012		4.20
500	2.06	277.0		-1.301		2.98
250	1.03	213.0		-0.971		2.41
0	0.00	114.0		-0.668		1.89

* Nominal yield stress

** Bolt #7 not working properly - data omitted

Table D.4. Results of Torsion Test: Franklin 4 lb/ft - 60 ksi Post;
Post W/O Splice.

TORSION TEST		
FRANKLIN 4 lb/ft *		
60 (ksi)		
NO SPLICE		
post length: 123 in		
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)
0	0.00	0.0
100	0.41	13.5
200	0.83	26.5
300	1.24	40.0
400	1.65	53.5
500	2.06	68.0
600	2.48	83.0
700	2.89	98.0
800	3.30	114.0
900	3.71	130.5
1000	4.13	142.0
1100	4.54	161.0
1200	4.95	185.0
1300	5.36	212.5
1400	5.78	246.5
1500	6.19	286.0
1600	6.60	325.0
1700	7.01	360.0
1000	4.13	298.0
500	2.06	240.0
0	0.00	158.0

* Nominal yield stress

Table D.5. Results of Torsion Test: Franklin 4 lb/ft - 60 ksi Post;
4 Inch Back to Back Splice (Calibrated and Grade 5 Field
Bolts).

TORSION TEST						
FRANKLIN 4 lb/ft - 60 ksi *					BOLT LOADS	
back to back; gr 5 bolts						
splice length: 4 in						
post length: 123 in						
					Bolt A	Bolt B
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Obs. (kips)	Obs. (kips)
loose			-0.136	0.115	0.00	0.00
tight			-2.633	-2.719	3.56	4.35
0	0.00	0.0	-2.569	-2.679	3.47	4.29
100	0.41	13.5	-2.561	-2.669	3.46	4.27
200	0.83	26.0	-2.556	-2.661	3.45	4.26
300	1.24	37.5	-2.574	-2.656	3.48	4.25
400	1.65	52.0	-2.639	-2.682	3.57	4.29
500	2.06	66.0	-2.746	-2.719	3.72	4.35
600	2.48	81.0	-2.890	-2.806	3.93	4.48
700	2.89	97.0	-3.077	-2.944	4.19	4.70
800	3.30	116.0	-3.227	-3.102	4.41	4.94
900	3.71	131.5	-3.436	-3.237	4.71	5.15
1000	4.13	146.5	-3.577	-3.349	4.91	5.32
1100	4.54	168.5	-3.782	-3.483	5.20	5.52
1200	4.95	201.5	-4.014	-3.764	5.53	5.95
1300	5.36	241.5	-4.125	-3.913	5.69	6.18
1400	5.78	270.0	-4.175	-4.104	5.76	6.48
1500	6.19	298.0	-4.220	-4.261	5.83	6.72
1600	6.60	335.0	-4.280	-4.397	5.91	6.93
1000	4.13	275.5	-3.512	-3.224	4.82	5.13
500	2.06	209.5	-2.712	-2.155	3.67	3.48
0	0.00	104.0	-2.200	-1.450	2.94	2.40

* Nominal yield stress

Table D.6. Results of Torsion Test: Franklin 4 lb/ft - 60 ksi Post;
4 Inch Nested Splice (Calibrated and Grade 5 Field
Bolts).

TORSION TEST						
FRANKLIN 4 lb/ft - 60 ksi *					BOLT LOADS	
nested; gr 5 bolts						
splice length: 4 in						
post length: 123 in						
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Bolt A Obs. (kips)	Bolt B Obs. (kips)
loose			-0.410	0.262	0.00	0.00
tight			-3.126	-0.251	3.87	0.79
0	0.00	0.0	-3.042	-0.257	3.75	0.80
100	0.41	13.0	-3.044	-0.220	3.76	0.74
200	0.83	26.5	-3.048	-0.249	3.76	0.78
300	1.24	40.5	-3.051	-0.249	3.77	0.78
400	1.65	54.0	-3.059	-0.291	3.78	0.85
500	2.06	68.5	-3.073	-0.362	3.80	0.96
600	2.48	83.0	-3.089	-0.441	3.82	1.08
700	2.89	98.0	-3.114	-0.550	3.86	1.25
800	3.30	116.5	-3.149	-0.690	3.91	1.46
900	3.71	132.5	-3.181	-0.820	3.95	1.66
1000	4.13	144.0	-3.203	-0.925	3.98	1.82
1100	4.54	164.5	-3.249	-1.087	4.05	2.07
1200	4.95	192.0	-3.313	-1.286	4.14	2.38
1300	5.36	223.5	-3.370	-1.507	4.22	2.72
1400	5.78	258.0	-3.425	-1.765	4.30	3.11
1400	5.78	286.5	-4.954	**	6.48	**
1000	4.13	242.5	-3.962	**	5.07	**
500	2.06	175.0	-2.611	**	3.14	**
0	0.00	86.0	-0.685	**	0.39	**

* Nominal yield stress

** bolt #8 breaks at 3.11 kips; probably due to fatigue since Pu = 12 kips

Table D.7. Results of Torsion Test: Marion 3 lb/ft - 80 ksi Post;
Post W/O Splice.

TORSION TEST		
MARION 3 lb/ft		
80 (ksi) *		
NO SPLICE		
post length: 123 in		
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)
0	0.00	0.0
50	0.21	14.0
100	0.41	28.5
150	0.62	42.5
200	0.83	67.5
250	1.03	72.0
300	1.24	86.0
350	1.44	100.0
400	1.65	114.0
450	1.86	128.5
500	2.06	138.0
550	2.27	148.0
600	2.48	161.0
650	2.68	177.0
700	2.89	189.0
750	3.09	204.5
800	3.30	219.5
850	3.51	234.5
900	3.71	251.0
950	3.92	269.0
1000	4.13	288.5
1050	4.33	306.0
1100	4.54	331.0
1200	4.95	380.0
500	2.06	222.0
0	0.00	73.5

* Nominal yield stress

Table D.8. Results of Torsion Test: Marion 3 lb/ft - 80 ksi Post;
3 Inch Back to Back Splice (Calibrated and Grade 5 Field
Bolts).

TORSION TEST						
MARION 3 lb/ft - 80 ksi *					BOLT LOADS	
back to back; gr 5 bolts						
splice length: 3 in						
post length: 123 in						
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Bolt A Obs. (kips)	Bolt B Obs. (kips)
loose			-0.308	0.097	0.00	0.00
tight			-2.034	-1.669	2.46	2.71
0	0.00	0.0	-2.101	-1.624	2.56	2.64
100	0.41	16.5	-2.097	-1.655	2.55	2.69
200	0.83	44.0	-2.102	-1.685	2.56	2.74
300	1.24	71.5	-2.119	-1.704	2.58	2.76
400	1.65	100.0	-2.144	-1.721	2.62	2.79
500	2.06	129.0	-2.144	-1.729	2.62	2.80
600	2.48	159.0	-2.140	-1.720	2.61	2.79
700	2.89	203.0	-2.144	-1.707	2.62	2.77
800	3.30	241.0	-2.124	-1.931	2.59	3.11
900	3.71	271.0	-2.124	-2.190	2.59	3.51
1000	4.13	305.0	-2.124	-2.449	2.59	3.91
1100	4.54	345.0	-2.115	-2.674	2.58	4.25
1200	4.95	383.0	-2.117	-2.813	2.58	4.47
1000	4.13	356.5	-1.947	-2.373	2.34	3.79
500	2.06	256.0	-1.621	-1.115	1.87	1.86
0	0.00	78.0	-1.533	-0.270	1.75	0.56

* Nominal yield stress

Table D.9. Results of Torsion Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice (Calibrated and Grade 5 Field Bolts).

TORSION TEST						
MARION 3 lb/ft - 80 ksi *					BOLT LOADS	
nested; gr 5 bolts						
splice length: 3 in						
post length: 123 in						
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Bolt A Obs. (kips)	Bolt B Obs. (kips)
loose			0.448	**	**	0.00
tight			-1.571			3.47
0	0.00	0.00	-1.455			3.27
100	0.41	28.50	-1.471			3.29
200	0.83	57.50	-1.523			3.38
300	1.24	86.50	-1.598			3.51
400	1.65	105.50	-1.671			3.64
500	2.06	138.00	-1.736			3.75
600	2.48	165.50	-1.806			3.87
700	2.89	195.50	-1.894			4.02
800	3.30	226.00	-2.062			4.31
900	3.71	260.50	-2.293			4.70
1000	4.13	296.50	-2.584			5.20
1100	4.54	340.00	-2.937			5.81
1200	4.95	384.00	-3.308			6.45
750	3.09	304.50	-2.455			4.98
500	2.06	260.00	-2.111			4.39
250	1.03	179.00	-1.559			3.44
0	0.00	94.00	-1.223			2.87

* Nominal yield stress

** Bolt #7 not working properly - data omitted

Table D.10. Results of Torsion Test: Marion 4 lb/ft - 80 ksi Post;
Post W/O Splice.

TORSION TEST		
MARION 4 lb/ft		
80 (ksi) *		
NO SPLICE		
post length: 123 in		
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)
0	0.00	0.0
100	0.41	11.5
200	0.83	23.0
300	1.24	33.5
400	1.65	45.0
500	2.06	56.5
600	2.48	68.5
700	2.89	79.0
800	3.30	91.0
900	3.71	112.0
1000	4.13	128.5
1100	4.54	139.5
1200	4.95	148.5
1300	5.36	164.5
1400	5.78	180.0
1500	6.19	201.0
1600	6.60	221.5
1700	7.01	246.5
1800	7.43	275.0
1900	7.84	307.0
2000	8.25	341.0
2100	8.66	375.0
1400	5.78	311.0
500	2.06	206.0
0	0.00	130.0

* Nominal yield stress

Table D.11. Results of Torsion Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice (Calibrated and Grade 5 Field Bolts).

TORSION TEST						
MARION 4 lb/ft - 80 ksi *					BOLT LOADS	
back to back; gr 5 bolts						
splice length: 4 in						
post length: 123 in						
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Bolt A Obs. (kips)	Bolt B Obs. (kips)
loose			-0.219	0.456	0.00	0.00
tight			-2.128	-1.674	2.72	3.27
0	0.00	0.0	-2.216	-1.595	2.85	3.15
100	0.41	10.5	-2.213	-1.602	2.84	3.16
200	0.83	20.0	-2.215	-1.607	2.85	3.17
300	1.24	31.0	-2.216	-1.609	2.85	3.17
400	1.65	41.5	-2.220	-1.612	2.85	3.17
500	2.06	51.0	-2.240	-1.613	2.88	3.18
600	2.48	62.0	-2.228	-1.612	2.87	3.17
700	2.89	71.5	-2.229	-1.608	2.87	3.17
800	3.30	82.5	-2.224	-1.602	2.86	3.16
900	3.71	93.5	-2.248	-1.593	2.89	3.15
900	3.71	109.0	-2.246	-1.560	2.89	3.09
1000	4.13	122.0	-2.301	-1.561	2.97	3.10
1100	4.54	134.5	-2.344	-1.547	3.03	3.07
1200	4.95	144.0	-2.400	-1.533	3.11	3.05
1300	5.36	158.0	-2.497	-1.546	3.25	3.07
1400	5.78	178.5	-2.653	-1.715	3.47	3.33
1500	6.19	202.0	-2.773	-1.867	3.64	3.57
1600	6.60	229.0	-2.857	-2.094	3.76	3.91
1700	7.01	257.5	-2.863	-2.328	3.77	4.27
1800	7.43	281.0	-2.862	-2.537	3.77	4.59
1900	7.84	305.5	-2.837	-2.748	3.73	4.92
2000	8.25	332.5	-2.818	-2.971	3.71	5.26
1000	4.13	243.5	-1.879	-1.127	2.37	2.43
500	2.06	179.0	-1.413	-0.274	1.70	1.12
0	0.00	90.0	-1.376	0.020	1.65	0.67

* Nominal yield stress

Table D.12. Results of Torsion Test: Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice (Calibrated and Grade 5 Field Bolts).

TORSION TEST						
MARION 4 lb/ft - 80 ksi *					BOLT LOADS	
nested; gr 5 bolts						
splice length: 4 in						
post length: 123 in						
Total Load (lbs)	Applied Moment (k-in)	Theta (deg)	Ch.#1 (mV)	Ch.#2 (mV)	Bolt A Obs. (kips)	Bolt B Obs. (kips)
loose			-0.228	0.572	0.00	0.00
tight			-1.873	-1.049	2.35	2.49
0	0.00	0.0	-1.780	-0.929	2.21	2.30
100	0.41	12.0	-1.750	-0.918	2.17	2.29
200	0.83	25.0	-1.697	-0.951	2.10	2.34
300	1.24	36.5	-1.682	-0.956	2.07	2.35
400	1.65	48.5	-1.665	-0.973	2.05	2.37
500	2.06	61.5	-1.633	-1.007	2.00	2.42
600	2.48	73.5	-1.606	-1.048	1.97	2.49
700	2.89	86.5	-1.614	-1.103	1.98	2.57
800	3.30	99.5	-1.555	-1.158	1.89	2.66
900	3.71	113.0	-1.539	-1.232	1.87	2.77
1000	4.13	126.0	-1.546	-1.326	1.88	2.91
1100	4.54	136.0	-1.538	-1.396	1.87	3.02
1200	4.95	145.5	-1.543	-1.477	1.88	3.15
1300	5.36	160.5	-1.552	-1.599	1.89	3.33
1400	5.78	177.0	-1.559	-1.749	1.90	3.56
1500	6.19	195.0	-1.571	-1.955	1.92	3.88
1600	6.60	216.5	-1.571	-2.210	1.92	4.27
1700	7.01	238.5	-1.585	-2.471	1.94	4.67
1800	7.43	263.0	-1.594	-2.753	1.95	5.10
1900	7.84	288.0	-1.601	-3.029	1.96	5.53
2000	8.25	319.5	-1.603	-3.338	1.96	6.00
1000	4.13	220.0	-1.387	-1.974	1.65	3.91
500	2.06	158.0	-1.236	-1.057	1.44	2.50
0	0.00	83.0	-1.072	-0.442	1.20	1.56

* Nominal yield stress

APPENDIX E

75" COMBINED BENDING AND TORSION TESTS
(NEGLECTING AND INCLUDING WARPING STRESSES)

FIELD BOLT SUMMARY TABLES

Franklin 3 & 4 lb/ft Posts - 60 ksi Nominal Yield Stress

Marion 3 & 4 lb/ft Posts - 80 ksi Nominal Yield Stress

Back to Back and Nested Splices

Critical Configuration

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Table E.1. Results of 75 Inch Combined Bending and Torsion Test (Neglecting Warping Stresses): Franklin 3 lb/ft - 60 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

LOAD (lbs)		Ch. #1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
0		1.003	0.00	0.0	6.30	0.052	0.052	1.94	0.00	0.00	1.94
26	26	1.238	0.60	7.5	6.25	0.198	0.195	6.74	2.80	0.00	7.75
24	50	1.457	1.18	13.0	6.14	0.335	0.327	11.17	5.34	0.00	13.32
24	74	1.671	1.83	17.5	6.01	0.468	0.460	15.61	7.83	0.00	18.86
24	98	1.878	2.47	22.0	5.84	0.597	0.592	20.04	10.24	0.00	24.35
24	122	2.080	3.12	25.0	5.71	0.723	0.724	24.47	12.61	0.01	29.80
24	146	2.276	3.76	28.0	5.56	0.845	0.856	28.90	14.91	0.01	35.21
24	170	2.472	4.43	30.0	5.46	0.967	0.989	33.32	17.17	0.01	40.59
24	194	2.646	5.13	32.5	5.31	1.076	1.121	37.74	19.36	0.01	45.92
24	218	2.813	5.84	34.5	5.19	1.180	1.253	42.17	21.51	0.02	51.22
24	242	2.976	6.70	36.0	5.10	1.281	1.384	46.58	23.62	0.02	56.48
24	266	3.095	7.65	38.0	4.96	1.355	1.516	50.99	25.68	0.03	61.71
24	290	3.146	8.81	39.0	4.90	1.387	1.647	55.40	27.70	0.04	66.90
8	298	3.249	9.24	40.0	4.83	1.451	1.691	56.86	28.37	0.04	68.63
8	306	3.124	9.81	40.5	4.79	1.374	1.735	58.33	29.03	0.04	70.35
8	314	3.036	10.55	41.5	4.72	1.319	1.779	59.79	29.68	0.05	72.06

* Nominal yield stress

Table E.2. Results of 75 Inch Combined Bending and Torsion Test
 (Neglecting Warping Stresses): Franklin 3 lb/ft - 60 ksi Post;
 3 Inch Nested Splice in Critical Configuration (Grade 5 Field
 Bolts).

						BENDING TORSION TEST (Warping Neglected) FRANKLIN 3 lb/ft - 60 ksi * Nested; gr 5 bolts Critical orientation					
LOAD (lbs)		Ch.#1	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot	(mV)				Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	0.411	0.00	0.0	6.30	0.052	0.051	1.94	0.00	0.00	1.94
26	26	0.177	0.61	7.0	6.25	0.198	0.194	6.75	2.80	0.00	7.76
24	50	-0.042	1.17	13.5	6.13	0.334	0.326	11.19	5.34	0.00	13.33
24	74	-0.261	1.71	18.5	5.97	0.471	0.458	15.63	7.81	0.00	18.86
24	98	-0.480	2.27	23.5	5.78	0.607	0.589	20.07	10.20	0.00	24.34
24	122	-0.701	2.85	27.0	5.61	0.745	0.721	24.51	12.52	0.01	29.78
24	146	-0.920	3.41	30.5	5.43	0.881	0.853	28.94	14.77	0.01	35.15
24	170	-1.137	3.98	34.0	5.22	1.017	0.985	33.38	16.93	0.01	40.47
24	194	-1.353	4.56	36.5	5.06	1.151	1.116	37.81	19.03	0.01	45.74
24	218	-1.569	5.22	38.0	4.96	1.286	1.248	42.24	21.08	0.02	50.98
24	242	-1.785	5.90	40.0	4.83	1.420	1.379	46.67	23.08	0.02	56.17
24	266	-1.999	6.70	42.5	4.64	1.554	1.511	51.09	25.00	0.03	61.31
24	290	-2.226	7.76	43.0	4.61	1.695	1.642	55.51	26.91	0.03	66.44
8	298	-2.323	8.30	44.0	4.53	1.755	1.685	56.98	27.53	0.04	68.14
8	306	-2.401	8.68	44.5	4.49	1.804	1.729	58.45	28.15	0.04	69.84
8	314	-2.493	9.16	45.0	4.45	1.861	1.773	59.92	28.77	0.04	71.53

* Nominal yield stress

Table E.3. Results of 75 Inch Combined Bending and Torsion Test (Neglecting Warping Stresses): Franklin 4 lb/ft - 60 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TORSION TEST (Warping Neglected) FRANKLIN 4 lb/ft - 60 ksi * Back to back; gr 5 bolts Critical orientation											
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		9.25									
Moment arm (in)		75.63									
Eccentricity (in)		6.30									
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	-0.888	0.00	0.0	6.30	0.049	0.049	1.45	0.00	0.00	1.45
55	55	-0.521	0.99	7.5	6.25	0.278	0.272	9.07	4.38	0.00	10.84
32	87	-0.320	1.51	11.5	6.17	0.403	0.402	13.50	6.90	0.00	16.41
32	119	-0.113	2.04	15.0	6.09	0.532	0.532	17.93	9.39	0.00	21.95
32	151	0.113	2.62	18.5	5.97	0.673	0.661	22.36	11.82	0.00	27.46
32	183	0.320	3.19	21.0	5.88	0.802	0.791	26.79	14.22	0.01	32.94
32	215	0.534	3.74	23.5	5.78	0.935	0.920	31.22	16.58	0.01	38.39
32	247	0.753	4.37	26.0	5.66	1.071	1.050	35.64	18.89	0.01	43.80
32	279	0.972	4.92	27.5	5.59	1.208	1.179	40.06	21.17	0.02	49.19
32	311	1.205	5.53	29.5	5.48	1.353	1.308	44.48	23.41	0.02	54.55
32	343	1.441	6.14	31.5	5.37	1.500	1.438	48.90	25.61	0.02	59.87
32	375	1.738	7.11	33.5	5.25	1.685	1.567	53.31	27.75	0.03	65.16

* Nominal yield stress

Table E.4. Results of 75 Inch Combined Bending and Torsion Test
 (Neglecting Warping Stresses): Franklin 4 lb/ft - 60 ksi Post;
 4 Inch Nested Splice in Critical Configuration (Grade 5 Field
 Bolts).

BENDING TORSION TEST (Warping Neglected) FRANKLIN 4 lb/ft - 60 ksi * Nested; gr 5 bolts Critical orientation											
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		7.06									
Moment arm (in)		75.56									
Eccentricity (in)		6.30									
LOAD (lbs)		Ch.#1	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot	(mV)				Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	0.367	0.00	0.0	6.30	0.053	0.053	1.41	0.00	0.00	1.41
55	55	-0.058	0.81	7.5	6.25	0.318	0.283	9.02	4.38	0.00	10.80
32	87	-0.300	1.72	15.5	6.07	0.469	0.416	13.45	6.86	0.00	16.33
32	119	-0.306	2.19	18.0	5.99	0.472	0.550	17.88	9.31	0.00	21.84
32	151	-0.530	2.66	22.0	5.84	0.612	0.684	22.30	11.69	0.00	27.31
32	183	-0.761	3.12	24.5	5.73	0.756	0.818	26.73	14.03	0.01	32.75
32	215	-1.002	3.61	27.5	5.59	0.906	0.951	31.15	16.31	0.01	38.14
32	247	-1.222	4.06	29.0	5.51	1.043	1.085	35.57	18.56	0.01	43.50
32	279	-1.467	4.53	32.0	5.34	1.196	1.218	40.00	20.74	0.01	48.82
32	311	-1.683	5.03	33.5	5.25	1.330	1.352	44.41	22.88	0.02	54.11
32	343	-1.927	5.57	35.5	5.13	1.482	1.485	48.83	24.98	0.02	59.36
32	375	-2.157	6.21	38.0	4.96	1.626	1.619	53.24	27.00	0.03	64.56
32	407	-2.426	6.95	40.0	4.83	1.793	1.752	57.65	28.97	0.03	69.73
32	439	-2.706	7.32	41.5	4.72	1.968	1.885	62.06	30.90	0.04	74.85
16	455	**	7.32	41.5	4.72	**	**	64.27	31.86	0.04	77.42

* Nominal yield stress

** Data not taken

Table E.5. Results of 75 Inch Combined Bending and Torsion Test (Neglecting Warping Stresses): Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 9 Field Bolts).

LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
DL		1.378	0.00	0.0	6.30	0.039	0.039	1.92	0.00	0.00	1.92
55	55	1.709	1.00	14.0	6.11	0.245	0.278	12.02	4.70	0.00	13.64
32	87	1.902	1.61	19.5	5.94	0.365	0.417	17.90	7.36	0.00	20.54
32	119	2.100	2.22	24.5	5.73	0.489	0.556	23.78	9.92	0.00	27.38
32	151	2.299	2.85	29.0	5.51	0.613	0.695	29.65	12.39	0.01	34.15
32	183	2.495	3.46	32.0	5.34	0.735	0.833	35.52	14.78	0.01	40.87
32	215	2.704	4.12	34.5	5.19	0.865	0.972	41.39	17.10	0.01	47.55
32	247	2.914	4.81	37.0	5.03	0.996	1.111	47.26	19.35	0.02	54.19
32	279	3.117	5.54	39.0	4.90	1.122	1.249	53.12	21.54	0.02	60.78
16	295	3.237	5.94	40.0	4.83	1.197	1.318	56.05	22.62	0.03	64.06
16	311	3.342	6.36	40.5	4.79	1.263	1.388	58.98	23.69	0.03	67.34
16	327	3.447	6.77	41.5	4.72	1.328	1.457	61.91	24.74	0.03	70.61
16	343	3.566	7.26	42.5	4.64	1.402	1.526	64.83	25.78	0.04	73.87
16	359	3.680	7.72	43.0	4.61	1.473	1.595	67.76	26.81	0.04	77.12
16	375	3.791	8.26	44.0	4.53	1.542	1.664	70.68	27.83	0.04	80.36
16	391	3.928	8.85	44.5	4.49	1.628	1.733	73.60	28.83	0.05	83.59

* Nominal yield stress

Table E.6. Results of 75 Inch Combined Bending and Torsion Test (Neglecting Warping Stresses): Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TORSION TEST (Warping Neglected) MARION 3 lb/ft - 80 ksi * Nested; gr 9 bolts Critical orientation											
Splice length (in)		3.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		10.13									
Moment arm (in)		73.50									
Eccentricity (in)		6.30									
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	0.994	0.00	0.0	6.30	0.039	0.039	1.92	0.00	0.00	1.92
50	50	0.607	0.87	13.0	6.14	0.280	0.249	10.86	4.29	0.00	12.35
24	74	0.423	1.28	18.0	5.99	0.395	0.350	15.15	6.30	0.00	17.43
24	98	0.237	1.66	22.0	5.84	0.511	0.451	19.45	8.26	0.00	22.48
24	122	0.053	2.08	26.0	5.66	0.625	0.552	23.74	10.16	0.00	27.49
24	146	-0.133	2.52	29.0	5.51	0.741	0.652	28.03	12.01	0.01	32.47
24	170	-0.317	2.95	32.0	5.34	0.856	0.753	32.31	13.80	0.01	37.41
24	194	-0.500	3.35	35.0	5.16	0.970	0.854	36.60	15.53	0.01	42.31
24	218	-0.685	3.82	36.5	5.06	1.085	0.954	40.89	17.23	0.01	47.19
24	242	-0.858	4.24	39.0	4.90	1.193	1.055	45.17	18.87	0.02	52.03
25	267	-1.061	4.75	41.0	4.75	1.319	1.160	49.63	20.54	0.02	57.04
25	292	-1.253	5.30	43.0	4.61	1.439	1.264	54.09	22.15	0.02	62.02
25	317	-1.449	5.88	44.0	4.53	1.561	1.369	58.55	23.73	0.03	66.98
24	341	-1.628	6.49	46.0	4.38	1.673	1.470	62.82	25.20	0.03	71.71
24	365	-1.815	7.20	47.0	4.30	1.789	1.570	67.10	26.64	0.04	76.42
24	389	-2.001	8.21	49.0	4.13	1.905	1.670	71.36	28.03	0.05	81.09
24	413	-2.049	9.23	50.0	4.05	1.935	1.770	75.62	29.38	0.06	85.75
24	437	-2.228	10.29	51.0	3.96	2.046	1.870	79.87	30.71	0.07	90.38
16	453	-2.400	10.81	51.5	3.92	2.154	1.936	82.70	31.59	0.07	93.45

* Nominal yield stress

Table E.7. Results of 75 Inch Combined Bending and Torsion Test (Neglecting Warping Stresses): Marion 4 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 9 Field Bolts).

							BENDING TORSION TEST (Warping Neglected) MARION 4 lb/ft - 80 ksi * Back to back; gr 9 bolts Critical orientation				
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		9.13									
Moment arm (in)		75.63									
Eccentricity (in)		6.30									
Appl. load (lbs)	Total Load (lbs)	Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
						Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	-0.245	0.00	0.0	6.30	0.038	0.038	1.45	0.00	0.00	1.45
55	55	0.060	0.67	7.5	6.25	0.228	0.210	9.08	3.10	0.00	10.04
32	87	0.222	1.03	10.5	6.19	0.329	0.310	13.52	4.88	0.00	15.10
32	119	0.394	1.42	13.0	6.14	0.436	0.410	17.96	6.65	0.00	20.16
32	151	0.558	1.79	16.5	6.04	0.538	0.510	22.40	8.40	0.00	25.20
32	183	0.738	2.22	19.5	5.94	0.650	0.610	26.84	10.11	0.00	30.22
32	215	0.909	2.60	21.5	5.86	0.757	0.709	31.28	11.80	0.01	35.23
32	247	1.092	3.01	24.0	5.76	0.871	0.809	35.71	13.46	0.01	40.22
32	279	1.262	3.36	25.5	5.69	0.977	0.909	40.15	15.10	0.01	45.20
32	311	1.445	3.79	27.5	5.59	1.091	1.009	44.58	16.71	0.01	50.16
32	343	1.611	4.23	29.0	5.51	1.194	1.109	49.02	18.30	0.02	55.11
32	375	1.782	4.64	30.5	5.43	1.301	1.208	53.45	19.87	0.02	60.04
32	407	1.966	5.07	32.5	5.31	1.416	1.308	57.88	21.40	0.02	64.95
32	439	2.125	5.48	33.5	5.25	1.515	1.408	62.31	22.91	0.03	69.85
32	471	2.344	6.02	34.5	5.19	1.651	1.507	66.73	24.41	0.03	74.74
32	503	2.514	6.51	35.5	5.13	1.757	1.607	71.16	25.89	0.04	79.61
32	535	2.723	7.24	37.0	5.03	1.887	1.706	75.58	27.34	0.04	84.47

* Nominal yield stress

Table E.8. Results of 75 Inch Combined Bending and Torsion Test (Neglecting Warping Stresses): Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 9 Field Bolts).

						BENDING TORSION TEST (Warping Neglected) MARION 4 lb/ft - 80 ksi * Nested; gr 9 bolts Critical orientation					
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		9.19									
Moment arm (in)		75.63									
Eccentricity (in)		6.30									
Appl. load (lbs)	Total Load (lbs)	Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
						Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	-0.488	0.00	0.0	6.30	0.038	0.038	1.40	0.00	0.00	1.40
55	55	-0.821	0.64	7.0	6.25	0.245	0.210	8.76	3.32	0.00	9.88
32	87	-1.003	1.02	11.0	6.18	0.359	0.310	13.04	5.23	0.00	14.88
32	119	-1.184	1.39	14.0	6.11	0.472	0.409	17.33	7.12	0.00	19.88
32	151	-1.355	1.77	17.5	6.01	0.578	0.509	21.61	8.98	0.00	24.85
32	183	-1.530	2.12	20.5	5.90	0.687	0.609	25.89	10.80	0.00	29.81
32	215	-1.706	2.48	23.5	5.78	0.797	0.709	30.17	12.59	0.01	34.74
32	247	-1.880	2.85	26.0	5.66	0.905	0.809	34.45	14.34	0.01	39.64
32	279	-2.044	3.24	28.5	5.54	1.007	0.908	38.73	16.05	0.01	44.52
32	311	-2.214	3.60	30.5	5.43	1.113	1.008	43.01	17.72	0.01	49.38
32	343	-2.379	4.00	32.5	5.31	1.216	1.108	47.28	19.37	0.01	54.22
32	375	-2.533	4.40	33.5	5.25	1.312	1.207	51.56	20.99	0.02	59.04
32	407	-2.713	4.83	36.0	5.10	1.424	1.307	55.83	22.56	0.02	63.83
32	439	-2.874	5.23	37.5	5.00	1.525	1.406	60.11	24.11	0.02	68.61
32	471	-3.043	5.65	39.0	4.90	1.630	1.506	64.38	25.62	0.03	73.36
32	503	-3.226	6.09	40.5	4.79	1.744	1.606	68.65	27.10	0.03	78.09
32	535	-3.396	6.09	42.0	4.68	1.850	1.705	72.92	28.55	0.04	82.80
24	559	-3.552	6.09	42.0	4.68	1.947	1.780	76.12	29.63	0.04	86.33

* Nominal yield stress

Table E.9. Results of 75 Inch Combined Bending and Torsion Test
 (Including Warping Stresses): Franklin 3 lb/ft - 60 ksi Post;
 3 Inch Back to Back Splice in Critical Configuration (Grade 5
 Field Bolts).

						BENDING TORSION TEST (Including Warping) FRANKLIN 3 lb/ft - 60 ksi * Back to back; gr 5 bolts Critical orientation					
LOAD (lbs)		Ch. #1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	0	1.003	0.00	0.0	6.30	0.052	0.052	1.94	0.00	0.00	1.94
26	26	1.238	0.60	7.5	6.25	0.198	0.246	8.26	1.49	0.00	8.52
24	50	1.457	1.18	13.0	6.14	0.335	0.424	14.07	2.85	0.00	14.62
24	74	1.671	1.83	17.5	6.01	0.468	0.601	19.85	4.17	0.00	20.69
24	98	1.878	2.47	22.0	5.84	0.597	0.777	25.59	5.46	0.00	26.71
24	122	2.080	3.12	25.0	5.71	0.723	0.952	31.31	6.72	0.01	32.69
24	146	2.276	3.76	28.0	5.56	0.845	1.126	36.98	7.94	0.01	38.63
24	170	2.472	4.43	30.0	5.46	0.967	1.299	42.64	9.15	0.01	44.53
24	194	2.646	5.13	32.5	5.31	1.076	1.471	48.25	10.32	0.01	50.38
24	218	2.813	5.84	34.5	5.19	1.180	1.642	53.84	11.46	0.02	56.20
24	242	2.976	6.70	36.0	5.10	1.281	1.812	59.40	12.59	0.02	61.98
24	266	3.095	7.65	38.0	4.96	1.355	1.980	64.92	13.68	0.03	67.72
24	290	3.146	8.81	39.0	4.90	1.387	2.149	70.43	14.76	0.04	73.43
8	298	3.249	9.24	40.0	4.83	1.451	2.204	72.26	15.12	0.04	75.33
8	306	3.124	9.81	40.5	4.79	1.374	2.260	74.08	15.47	0.04	77.22
8	314	3.036	10.55	41.5	4.72	1.319	2.316	75.90	15.81	0.05	79.11

* Nominal yield stress

Table E.10. Results of 75 Inch Combined Bending and Torsion Test
(Including Warping Stresses): Franklin 3 lb/ft - 60 ksi Post;
3 Inch Nested Splice in Critical Configuration (Grade 5 Field
Bolts).

					BENDING TORSION TEST (Including Warping) FRANKLIN 3 lb/ft - 60 ksi * Nested; gr 5 bolts Critical orientation						
LOAD (lbs)		Ch.#1	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot	(mV)				Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	0.411	0.00	0.0	6.30	0.052	0.051	1.94	0.00	0.00	1.94
26	26	0.177	0.61	7.0	6.25	0.198	0.245	8.27	1.49	0.00	8.53
24	50	-0.042	1.17	13.5	6.13	0.334	0.422	14.08	2.84	0.00	14.64
24	74	-0.261	1.71	18.5	5.97	0.471	0.599	19.87	4.16	0.00	20.70
24	98	-0.480	2.27	23.5	5.78	0.607	0.774	25.60	5.44	0.00	26.71
24	122	-0.701	2.85	27.0	5.61	0.745	0.948	31.30	6.67	0.01	32.67
24	146	-0.920	3.41	30.5	5.43	0.881	1.120	36.96	7.87	0.01	38.57
24	170	-1.137	3.98	34.0	5.22	1.017	1.291	42.56	9.02	0.01	44.41
24	194	-1.353	4.56	36.5	5.06	1.151	1.460	48.13	10.14	0.01	50.19
24	218	-1.569	5.22	38.0	4.96	1.286	1.629	53.68	11.23	0.02	55.95
24	242	-1.785	5.90	40.0	4.83	1.420	1.797	59.19	12.30	0.02	61.66
24	266	-1.999	6.70	42.5	4.64	1.554	1.963	64.66	13.32	0.03	67.32
24	290	-2.226	7.76	43.0	4.61	1.695	2.128	70.11	14.34	0.03	72.96
8	298	-2.323	8.30	44.0	4.53	1.755	2.183	71.92	14.67	0.04	74.83
8	306	-2.401	8.68	44.5	4.49	1.804	2.238	73.73	15.00	0.04	76.70
8	314	-2.493	9.16	45.0	4.45	1.861	2.293	75.53	15.33	0.04	78.56

* Nominal yield stress

Table E.11. Results of 75 Inch Combined Bending and Torsion Test (Including Warping Stresses): Franklin 4 lb/ft - 60 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Grade 5 Field Bolts).

BENDING TORSION TEST (Including Warping) FRANKLIN 4 lb/ft - 60 ksi * Back to back; gr 5 bolts Critical orientation											
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		9.25									
Moment arm (in)		75.63									
Eccentricity (in)		6.30									
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	-0.888	0.00	0.0	6.30	0.049	0.049	1.45	0.00	0.00	1.45
55	55	-0.521	0.99	7.5	6.25	0.278	0.309	10.18	3.61	0.00	11.33
32	87	-0.320	1.51	11.5	6.17	0.403	0.460	15.25	5.69	0.00	17.14
32	119	-0.113	2.04	15.0	6.09	0.532	0.611	20.31	7.73	0.00	22.92
32	151	0.113	2.62	18.5	5.97	0.673	0.761	25.36	9.74	0.00	28.67
32	183	0.320	3.19	21.0	5.88	0.802	0.911	30.39	11.72	0.01	34.39
32	215	0.534	3.74	23.5	5.78	0.935	1.060	35.42	13.66	0.01	40.08
32	247	0.753	4.37	26.0	5.66	1.071	1.209	40.43	15.57	0.01	45.74
32	279	0.972	4.92	27.5	5.59	1.208	1.358	45.43	17.45	0.02	51.37
32	311	1.205	5.53	29.5	5.48	1.353	1.506	50.41	19.29	0.02	56.97
32	343	1.441	6.14	31.5	5.37	1.500	1.654	55.39	21.10	0.02	62.53
32	375	1.738	7.11	33.5	5.25	1.685	1.801	60.34	22.86	0.03	68.05

* Nominal yield stress

Table E.12. Results of 75 Inch Combined Bending and Torsion Test
 (Including Warping Stresses): Franklin 4 lb/ft - 60 ksi Post;
 4 Inch Nested Splice in Critical Configuration (Grade 5 Field
 Bolts).

BENDING TORSION TEST (Including Warping) FRANKLIN 4 lb/ft - 60 ksi * Nested; gr 5 bolts Critical orientation											
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		7.06									
Moment arm (in)		75.56									
Eccentricity (in)		6.30									
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	0.367	0.00	0.0	6.30	0.053	0.053	1.41	0.00	0.00	1.41
55	55	-0.058	0.81	7.5	6.25	0.318	0.320	10.14	3.61	0.00	11.29
32	87	-0.300	1.72	15.5	6.07	0.469	0.474	15.20	5.65	0.00	17.07
32	119	-0.306	2.19	18.0	5.99	0.472	0.629	20.25	7.67	0.00	22.83
32	151	-0.530	2.66	22.0	5.84	0.612	0.783	25.28	9.63	0.00	28.54
32	183	-0.761	3.12	24.5	5.73	0.756	0.936	30.30	11.56	0.01	34.22
32	215	-1.002	3.61	27.5	5.59	0.906	1.089	35.31	13.44	0.01	39.85
32	247	-1.222	4.06	29.0	5.51	1.043	1.242	40.30	15.29	0.01	45.46
32	279	-1.467	4.53	32.0	5.34	1.196	1.394	45.28	17.09	0.01	51.02
32	311	-1.683	5.03	33.5	5.25	1.330	1.545	50.25	18.85	0.02	56.55
32	343	-1.927	5.57	35.5	5.13	1.482	1.696	55.20	20.58	0.02	62.04
32	375	-2.157	6.21	38.0	4.96	1.626	1.847	60.13	22.25	0.03	67.49
32	407	-2.426	6.95	40.0	4.83	1.793	1.997	65.04	23.87	0.03	72.89
32	439	-2.706	7.32	41.5	4.72	1.968	2.146	69.94	25.46	0.04	78.26
16	455	**	7.32	41.5	4.72	**	**	72.39	26.25	0.04	80.94

* Nominal yield stress

** Data not taken

Table E.13. Results of 75 Inch Combined Bending and Torsion Test (Including Warping Stresses): Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TORSION TEST (Including Warping) MARION 3 lb/ft - 80 ksi * Back to back; gr 9 bolts Critical orientation											
LOAD (lbs)		Ch.#1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	1.378	0.00	0.0	6.30	0.039	0.039	1.92	0.00	0.00	1.92
55	55	1.709	1.00	14.0	6.11	0.245	0.383	15.17	3.09	0.00	15.78
32	87	1.902	1.61	19.5	5.94	0.365	0.581	22.82	4.83	0.00	23.81
32	119	2.100	2.22	24.5	5.73	0.489	0.777	30.42	6.52	0.00	31.76
32	151	2.299	2.85	29.0	5.51	0.613	0.971	37.94	8.14	0.01	39.62
32	183	2.495	3.46	32.0	5.34	0.735	1.163	45.41	9.71	0.01	47.41
32	215	2.704	4.12	34.5	5.19	0.865	1.354	52.84	11.24	0.01	55.14
32	247	2.914	4.81	37.0	5.03	0.996	1.542	60.21	12.72	0.02	62.80
32	279	3.117	5.54	39.0	4.90	1.122	1.730	67.54	14.16	0.02	70.41
16	295	3.237	5.94	40.0	4.83	1.197	1.823	71.19	14.86	0.03	74.19
16	311	3.342	6.36	40.5	4.79	1.263	1.916	74.84	15.57	0.03	77.97
16	327	3.447	6.77	41.5	4.72	1.328	2.009	78.47	16.26	0.03	81.74
16	343	3.566	7.26	42.5	4.64	1.402	2.101	82.09	16.95	0.04	85.49
16	359	3.680	7.72	43.0	4.61	1.473	2.193	85.70	17.62	0.04	89.22
16	375	3.791	8.26	44.0	4.53	1.542	2.285	89.30	18.29	0.04	92.95
16	391	3.928	8.85	44.5	4.49	1.628	2.376	92.90	18.95	0.05	96.66

* Nominal yield stress

Table E.14. Results of 75 Inch Combined Bending and Torsion Test (Including Warping Stresses): Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Critical Configuration (Grade 9 Field Bolts).

						BENDING TORSION TEST (Including Warping) MARION 3 lb/ft - 80 ksi * Nested; gr 9 bolts Critical orientation					
LOAD (lbs)		Ch.#1	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
Appl	Tot	(mV)				Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	0.994	0.00	0.0	6.30	0.039	0.039	1.92	0.00	0.00	1.92
50	50	0.607	0.87	13.0	6.14	0.280	0.345	13.73	2.82	0.00	14.29
24	74	0.423	1.28	18.0	5.99	0.395	0.491	19.37	4.14	0.00	20.22
24	98	0.237	1.66	22.0	5.84	0.511	0.635	24.97	5.43	0.00	26.10
24	122	0.053	2.08	26.0	5.66	0.625	0.778	30.54	6.68	0.00	31.94
24	146	-0.133	2.52	29.0	5.51	0.741	0.920	36.06	7.89	0.01	37.72
24	170	-0.317	2.95	32.0	5.34	0.856	1.061	41.55	9.07	0.01	43.45
24	194	-0.500	3.35	35.0	5.16	0.970	1.200	47.00	10.21	0.01	49.13
24	218	-0.685	3.82	36.5	5.06	1.085	1.339	52.42	11.32	0.01	54.77
24	242	-0.858	4.24	39.0	4.90	1.193	1.476	57.80	12.40	0.02	60.37
25	267	-1.061	4.75	41.0	4.75	1.319	1.618	63.38	13.50	0.02	66.15
25	292	-1.253	5.30	43.0	4.61	1.439	1.758	68.92	14.55	0.02	71.89
25	317	-1.449	5.88	44.0	4.53	1.561	1.898	74.43	15.60	0.03	77.60
24	341	-1.628	6.49	46.0	4.38	1.673	2.032	79.69	16.56	0.03	83.03
24	365	-1.815	7.20	47.0	4.30	1.789	2.164	84.93	17.51	0.04	88.43
24	389	-2.001	8.21	49.0	4.13	1.905	2.295	90.12	18.42	0.05	93.79
24	413	-2.049	9.23	50.0	4.05	1.935	2.426	95.29	19.31	0.06	99.11
24	437	-2.228	10.29	51.0	3.96	2.046	2.555	100.44	20.19	0.07	104.41
16	453	-2.400	10.81	51.5	3.92	2.154	2.641	103.86	20.76	0.07	107.92

* Nominal yield stress

Table E.15. Results of 75 Inch Combined Bending and Torsion Test
(Including Warping Stresses): Marion 4 lb/ft - 80 ksi Post; 4
Inch Back to Back Splice in Critical Configuration (Grade 9
Field Bolts).

						BENDING TORSION TEST (Including Warping) MARION 4 lb/ft - 80 ksi * Back to back; gr 9 bolts Critical orientation					
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		9.13									
Moment arm (in)		75.63									
Eccentricity (in)		6.30									
Appl. Total		Ch.#1	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
load (lbs)	Load (lbs)					Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	-0.245	0.00	0.0	6.30	0.038	0.038	1.45	0.00	0.00	1.45
55	55	0.060	0.67	7.5	6.25	0.228	0.256	10.46	3.61	0.00	11.58
32	87	0.222	1.03	10.5	6.19	0.329	0.382	15.69	5.69	0.00	17.54
32	119	0.394	1.42	13.0	6.14	0.436	0.508	20.92	7.76	0.00	23.48
32	151	0.558	1.79	16.5	6.04	0.538	0.634	26.13	9.79	0.00	29.39
32	183	0.738	2.22	19.5	5.94	0.650	0.759	31.33	11.79	0.00	35.27
32	215	0.909	2.60	21.5	5.86	0.757	0.884	36.52	13.76	0.01	41.13
32	247	1.092	3.01	24.0	5.76	0.871	1.009	41.69	15.69	0.01	46.95
32	279	1.262	3.36	25.5	5.69	0.977	1.133	46.86	17.61	0.01	52.74
32	311	1.445	3.79	27.5	5.59	1.091	1.256	52.01	19.48	0.01	58.51
32	343	1.611	4.23	29.0	5.51	1.194	1.380	57.15	21.34	0.02	64.25
32	375	1.782	4.64	30.5	5.43	1.301	1.503	62.28	23.16	0.02	69.96
32	407	1.966	5.07	32.5	5.31	1.416	1.625	67.39	24.95	0.02	75.64
32	439	2.125	5.48	33.5	5.25	1.515	1.747	72.49	26.72	0.03	81.30
32	471	2.344	6.02	34.5	5.19	1.651	1.869	77.58	28.46	0.03	86.93
32	503	2.514	6.51	35.5	5.13	1.757	1.990	82.66	30.19	0.04	92.54
32	535	2.723	7.24	37.0	5.03	1.887	2.111	87.73	31.88	0.04	98.13

* Nominal yield stress

Table E.16. Results of 75 Inch Combined Bending and Torsion Test (Including Warping Stresses): Marion 4 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Grade 9 Field Bolts).

BENDING TORSION TEST (Including Warping) MARION 4 lb/ft - 80 ksi * Nested; gr 9 bolts Critical orientation											
Splice length (in)		4.00									
Dist to bolt A (in)		1.50									
Dist to strain gauge (in) .		9.19									
Moment arm (in)		75.63									
Eccentricity (in)		6.30									
Appl. load (lbs)	Total Load (lbs)	Ch. #1 (mV)	Tip Defl (in)	Tip Rot (deg)	Tor Arm (in)	STRAIN At Gauge (uin/in)		BASE STRESSES (ksi)			
						Obs.	Calc.	Bending Mc/I	Torsion Th/J	Axial P/A	Combined (Mohr)
	DL	-0.488	0.00	0.0	6.30	0.038	0.038	1.40	0.00	0.00	1.40
55	55	-0.821	0.64	7.0	6.25	0.245	0.256	10.41	3.61	0.00	11.54
32	87	-1.003	1.02	11.0	6.18	0.359	0.382	15.64	5.69	0.00	17.49
32	119	-1.184	1.39	14.0	6.11	0.472	0.508	20.86	7.75	0.00	23.43
32	151	-1.355	1.77	17.5	6.01	0.578	0.633	26.07	9.77	0.00	29.33
32	183	-1.530	2.12	20.5	5.90	0.687	0.758	31.27	11.75	0.00	35.20
32	215	-1.706	2.48	23.5	5.78	0.797	0.883	36.44	13.70	0.01	41.02
32	247	-1.880	2.85	26.0	5.66	0.905	1.007	41.61	15.60	0.01	46.81
32	279	-2.044	3.24	28.5	5.54	1.007	1.130	46.75	17.46	0.01	52.57
32	311	-2.214	3.60	30.5	5.43	1.113	1.253	51.88	19.29	0.01	58.28
32	343	-2.379	4.00	32.5	5.31	1.216	1.375	57.00	21.08	0.01	63.96
32	375	-2.533	4.40	33.5	5.25	1.312	1.497	62.11	22.84	0.02	69.62
32	407	-2.713	4.83	36.0	5.10	1.424	1.619	67.19	24.56	0.02	75.23
32	439	-2.874	5.23	37.5	5.00	1.525	1.740	72.26	26.24	0.02	80.80
32	471	-3.043	5.65	39.0	4.90	1.630	1.860	77.32	27.88	0.03	86.35
32	503	-3.226	6.09	40.5	4.79	1.744	1.980	82.36	29.49	0.03	91.86
32	535	-3.396	6.09	42.0	4.68	1.850	2.100	87.38	31.07	0.04	97.33
24	559	-3.552	6.09	42.0	4.68	1.947	2.189	91.15	32.25	0.04	101.44

* Nominal yield stress

APPENDIX F

PRELIMINARY 72 " BENDING TESTS

CALIBRATED BOLT SUMMARY TABLES

Marion 3 lb/ft Posts - 80 ksi Nominal Yield Stress

Back to Back, Nested and Face to Face Splices

Critical and Non-critical Configurations

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Table F.1. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 3.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.25				Back to back splice							
Dist to strain gauge (in) .. 8.00				Critical orientation							
Moment arm (in)72.25											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
Appl Tot											
floor	-0.791	-0.580	7.325								
tight	-2.575	-3.428	7.321			2.69	4.48				
DL	-2.602	-3.137	7.048	0.00	0.00	2.73	4.02	0.042	0.042	1.90	1.26
60 60	-2.605	-3.071	7.499	0.72	0.72	2.74	3.91	0.323	0.297	12.45	9.69
32 92	-2.603	-3.043	7.732	0.39	1.11	2.73	3.87	0.468	0.433	18.07	14.04
32 124	-2.598	-3.019	7.969	0.40	1.50	2.73	3.83	0.616	0.570	23.70	18.47
32 156	-2.592	-3.016	8.220	0.43	1.94	2.72	3.83	0.772	0.706	29.32	23.17
32 188	-2.586	-3.029	8.464	0.42	2.35	2.71	3.85	0.924	0.842	34.95	27.73
32 220	-2.563	-3.092	8.690	0.40	2.75	2.67	3.95	1.065	0.978	40.57	31.95
32 252	-2.542	-3.265	8.934	0.44	3.19	2.64	4.22	1.217	1.115	46.20	36.51
32 284	-2.504	-3.422	9.181	0.46	3.65	2.58	4.47	1.371	1.251	51.82	41.13
32 316	-2.454	-3.621	9.426	0.51	4.15	2.51	4.78	1.524	1.387	57.45	45.71
32 348	-2.396	-3.799	9.646	0.48	4.63	2.42	5.06	1.661	1.523	63.07	49.82
32 380	-2.337	-4.001	9.877	0.53	5.16	2.33	5.38	1.805	1.660	68.70	54.14
16 396	-2.307	-4.100	9.989	0.27	5.42	2.29	5.53	1.874	1.728	71.51	56.23
16 412	-2.277	-4.196	10.100	0.26	5.68	2.24	5.68	1.944	1.796	74.32	58.31
16 428	-2.244	-4.286	10.210	0.29	5.97	2.19	5.82	2.012	1.864	77.14	60.36
16 444	-2.214	-4.392	10.330	0.30	6.27	2.15	5.99	2.087	1.932	79.95	62.61
16 460	-2.180	-4.467	10.440	0.29	6.55	2.10	6.11	2.155	2.000	82.76	64.66
16 476	-2.145	-4.544	10.550	0.31	6.86	2.04	6.23	2.224	2.068	85.57	66.72
16 492	-2.116	-4.643	10.670	0.31	7.17	2.00	6.38	2.299	2.137	88.39	68.96

Effective splice length (critical bolt) 5.0 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.2. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in)				3.00		MARION 3 LB/FT POST - 80 ksi *					
Dist to bolt A (in)				1.06		Nested splice					
Dist to strain gauge (in) ..				7.75		Critical orientation					
Moment arm (in)				72.06							
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
floor	-0.765	-0.531	4.797								
tight	-3.959	-4.029	4.112			4.82	5.50				
DL	-3.683	-3.918	9.506	0.00	0.00	4.40	5.32	0.042	0.042	1.90	1.26
60 60	-3.432	-3.992	9.964	0.88	0.88	4.02	5.44	0.327	0.298	12.42	9.82
32 92	-3.338	-4.060	10.190	0.44	1.32	3.88	5.55	0.468	0.434	18.03	14.04
32 124	-3.242	-4.123	10.400	0.57	1.89	3.74	5.64	0.599	0.571	23.64	17.97
32 156	-3.150	-4.203	10.640	0.52	2.41	3.60	5.77	0.749	0.707	29.25	22.46
32 188	-3.081	-4.285	10.860	0.50	2.91	3.49	5.90	0.886	0.843	34.86	26.57
32 220	-3.022	-4.374	10.100	0.58	3.48	3.41	6.04	0.412	0.980	40.47	12.36
32 252	-2.987	-4.472	11.330	0.58	4.06	3.35	6.19	1.178	1.116	46.08	35.35
32 284	-2.969	-4.515	11.530	0.54	4.60	3.33	6.26	1.303	1.252	51.69	39.09
32 316	-2.962	-4.596	11.760	0.68	5.28	3.31	6.39	1.446	1.389	57.30	43.39
16 332	-2.965	-4.640	11.890	0.43	5.71	3.32	6.46	1.527	1.457	60.11	45.82
16 348	-2.970	-4.658	12.010	0.40	6.11	3.33	6.48	1.602	1.525	62.91	48.06
16 364	-2.976	-4.700	12.120	0.36	6.46	3.34	6.55	1.671	1.593	65.72	50.12

Effective splice length (critical bolt) 3.8 in

Effective splice length (both bolts) 3.8 in

* Nominal yield stress

Table F.3. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Face to Face Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 3.00						MARION 3 LB/FT POST - 80 ksi *					
Dist to bolt A (in) 1.63						Face to face splice					
Dist to strain gauge (in) .. 8.25						Critical orientation					
Moment arm (in)72.63											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
Appl Tot											
floor	1.081	0.708	2.259								
tight	0.388	-0.349	2.230			1.30	2.09				
DL	0.454	-0.366	2.156	0.00	0.00	1.18	2.13	0.041	0.041	1.90	1.23
60 60	0.622	-0.649	1.739	1.02	1.02	0.86	2.69	0.301	0.297	12.50	9.02
32 92	0.699	-0.813	1.528	0.52	1.54	0.72	3.01	0.432	0.434	18.16	12.97
32 124	0.771	-1.088	1.303	0.57	2.11	0.58	3.56	0.572	0.570	23.81	17.17
32 156	0.834	-1.227	1.094	0.55	2.65	0.46	3.83	0.703	0.707	29.47	21.08
32 188	0.879	-1.483	0.890	0.43	3.09	0.38	4.34	0.830	0.844	35.12	24.89
32 220	0.931	-1.819	0.648	0.69	3.77	0.28	5.01	0.981	0.980	40.78	29.42
16 236	0.949	-1.980	0.534	0.32	4.09	0.25	5.33	1.052	1.048	43.60	31.55
16 252	0.969	-2.128	0.433	0.31	4.40	0.21	5.62	1.115	1.117	46.43	33.44
16 268	0.983	-2.285	0.327	0.31	4.71	0.18	5.93	1.181	1.185	49.26	35.42
16 284	1.001	-2.454	0.211	0.36	5.07	0.15	6.27	1.253	1.253	52.09	37.59
16 300	1.022	-2.651	0.076	0.55	5.62	0.11	6.66	1.337	1.321	54.91	40.11
16 316	1.036	-2.794	-0.026	0.34	5.96	0.08	6.94	1.400	1.390	57.74	42.01
16 332	1.056	-2.948	-0.131	0.41	6.36	0.05	7.24	1.466	1.458	60.57	43.98

Effective splice length (critical bolt) 3.1 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.4. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Back to Back Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 3.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.38				Back to back splice							
Dist to strain gauge (in) . 7.88				Non-critical orientation							
Moment arm (in)72.38											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
Appl Tot											
floor	-0.874	-0.598	95.490								
tight	-3.068	-2.926	30.230			3.31	3.66				
DL	-3.069	-2.847	7.649	0.00	0.00	3.31	3.53	0.042	0.042	1.90	1.26
60 60	-3.087	-2.884	7.326	0.75	0.75	3.34	3.59	0.243	0.298	12.46	7.30
32 92	-3.116	-2.891	7.196	0.39	1.14	3.38	3.60	0.324	0.435	18.10	9.73
32 124	-3.164	-2.910	7.012	0.39	1.53	3.46	3.63	0.439	0.572	23.73	13.17
32 156	-3.229	-2.928	6.834	0.41	1.94	3.55	3.66	0.550	0.709	29.37	16.49
32 188	-3.325	-2.942	6.654	0.43	2.36	3.70	3.68	0.662	0.845	35.00	19.86
32 220	-3.514	-2.947	6.460	0.43	2.79	3.98	3.69	0.783	0.982	40.64	23.48
32 252	-3.717	-2.956	6.281	0.45	3.24	4.29	3.71	0.894	1.119	46.27	26.83
32 284	-3.927	-2.960	6.073	0.48	3.72	4.61	3.71	1.024	1.256	51.91	30.72
32 316	-4.162	-2.954	5.863	0.52	4.23	4.96	3.70	1.155	1.393	57.54	34.64
32 348	-4.385	-2.928	5.671	0.50	4.73	5.30	3.66	1.274	1.529	63.18	38.23
32 380	-4.611	-2.900	5.464	0.54	5.27	5.64	3.62	1.403	1.666	68.81	42.10
32 412	-4.805	-2.867	5.257	0.58	5.85	5.93	3.57	1.532	1.803	74.45	45.97
32 444	-4.861	-2.840	5.125	0.59	6.44	6.02	3.52	1.615	1.940	80.08	48.44

Effective splice length (critical bolt) 5.0 in

Effective splice length (both bolts) N/A

* Nominal yeild stress

Table F.5. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Nested Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 3.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.33				Nested splice							
Dist to strain gauge (in) 8.00				Non-critical orientation							
Moment arm (in) 72.33											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
Appl Tot											
floor	-0.766	-0.673	8.314								
tight	-3.414	-3.374	7.561			3.98	4.24				
DL	-3.353	-3.186	8.184	0.00	0.00	3.89	3.95	0.042	0.042	1.90	1.26
60 60	-3.509	-3.019	7.792	0.90	0.90	4.12	3.69	0.286	0.298	12.46	8.59
32 92	-3.600	-2.934	7.594	0.51	1.41	4.26	3.55	0.410	0.434	18.09	12.29
32 124	-3.712	-2.864	7.384	0.53	1.94	4.43	3.44	0.540	0.570	23.72	16.21
32 156	-3.828	-2.808	7.160	0.56	2.50	4.60	3.35	0.680	0.707	29.35	20.40
32 188	-3.965	-2.768	6.898	0.62	3.11	4.81	3.29	0.843	0.843	34.98	25.30
32 220	-4.063	-2.756	6.681	0.54	3.65	4.96	3.27	0.978	0.980	40.61	29.35
32 252	-4.193	-2.761	6.459	0.60	4.24	5.16	3.28	1.117	1.116	46.25	33.50
32 284	-4.279	-2.787	6.234	0.67	4.91	5.29	3.32	1.257	1.252	51.88	37.71
32 316	-4.400	-2.817	6.015	0.63	5.53	5.47	3.37	1.393	1.389	57.51	41.80
32 348	-4.486	-2.858	5.283	0.63	6.16	5.60	3.43	1.849	1.525	63.14	55.48
16 364	-4.500	-2.883	5.720	0.35	6.51	5.62	3.47	1.577	1.594	65.96	47.32
16 380	-4.524	-2.907	5.621	0.37	6.88	5.65	3.51	1.639	1.662	68.77	49.17
16 396	-4.539	-2.933	5.516	0.37	7.24	5.68	3.55	1.704	1.730	71.59	51.13
16 412	-4.541	-2.957	5.437	0.36	7.60	5.68	3.59	1.754	1.798	74.40	52.61

Effective splice length (critical bolt) 4.9 in

Effective splice length (both bolts) 4.6 in

* Nominal yield stress

Table F.6. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 3 Inch Face to Face Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in)				3.00		MARION 3 LB/FT POST - 80 ksi *					
Dist to bolt A (in)				1.31		Face to face splice					
Dist to strain gauge (in) ..				7.75		Non-critical orientation					
Moment arm (in)				72.19							
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
Appl Tot											
floor	1.077	0.707	2.240								
tight	0.768	-0.433	2.226			0.58	2.26				
DL	0.775	-0.277	2.319	0.00	0.00	0.57	1.95	0.041	0.041	1.90	1.23
60 60	0.342	0.026	2.801	1.10	1.10	1.38	1.35	0.341	0.297	12.44	10.24
32 92	0.100	0.141	3.020	0.53	1.63	1.83	1.12	0.478	0.434	18.06	14.33
32 124	-0.155	0.242	3.233	0.53	2.16	2.31	0.92	0.610	0.570	23.68	18.31
48 172	-0.502	0.391	3.479	0.80	2.96	2.96	0.63	0.764	0.775	32.11	22.91
32 204	-0.782	0.445	3.682	0.43	3.39	3.49	0.52	0.890	0.912	37.73	26.71
32 236	-1.073	0.503	3.891	0.67	4.06	4.03	0.40	1.020	1.049	43.35	30.61
32 268	-1.344	0.562	4.088	0.60	4.65	4.54	0.29	1.143	1.185	48.97	34.30
16 284	-1.513	0.589	4.211	0.34	4.99	4.86	0.23	1.220	1.254	51.78	36.59
16 300	-1.672	0.613	4.324	0.34	5.33	5.16	0.19	1.290	1.322	54.59	38.71
16 316	-1.809	0.634	4.425	0.31	5.63	5.41	0.14	1.353	1.390	57.40	40.59

Effective splice length (critical bolt) 4.0 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.7. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 4.00				MARION 3 lb/ft post - 80ksi *							
Dist to bolt A (in) 1.56				Back to back splice							
Dist to strain gauge (in) 9.06				Critical orientation							
Moment arm (in)72.56											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs	Calc	Base	Obs @ Gauge
Appl Tot											
floor	-0.651	-0.707	0.031								
tight	-4.857	-3.784	0.007			6.35	4.84				
DL	-4.867	-3.712	0.079	0.00	0.00	6.36	4.72	0.057	0.041	1.90	1.72
60 60	-4.895	-3.671	0.502	0.79	0.79	6.40	4.66	0.321	0.293	12.49	9.63
32 92	-4.901	-3.656	0.702	0.40	1.19	6.41	4.63	0.446	0.428	18.14	13.37
32 124	-4.906	-3.651	0.910	0.42	1.61	6.42	4.63	0.575	0.562	23.79	17.26
32 156	-4.907	-3.653	1.134	0.46	2.07	6.42	4.63	0.715	0.697	29.44	21.44
32 188	-4.902	-3.659	1.343	0.42	2.49	6.41	4.64	0.845	0.832	35.09	25.35
32 220	-4.898	-3.679	1.550	0.42	2.90	6.41	4.67	0.974	0.966	40.74	29.22
32 252	-4.875	-3.721	1.781	0.47	3.37	6.37	4.74	1.118	1.101	46.39	33.54
32 284	-4.866	-3.811	1.997	0.44	3.81	6.36	4.88	1.252	1.236	52.04	37.57
32 316	-4.847	-4.068	2.209	0.46	4.27	6.33	5.28	1.385	1.370	57.69	41.54
32 348	-4.816	-4.314	2.400	0.43	4.70	6.28	5.67	1.504	1.505	63.34	45.11
32 380	-4.783	-4.601	2.621	0.59	5.29	6.23	6.12	1.641	1.640	68.99	49.24
32 412	-4.741	-4.927	2.874	0.59	5.87	6.17	6.63	1.799	1.774	74.64	53.97
16 428	-4.699	-5.067	2.985	0.26	6.13	6.11	6.85	1.868	1.842	77.46	56.04
16 444	-4.678	-5.195	3.079	0.23	6.36	6.08	7.05	1.927	1.909	80.29	57.80
16 460	-4.657	-5.339	3.191	0.25	6.61	6.04	7.28	1.996	1.976	83.11	59.89
16 476	-4.614	-5.465	3.290	0.24	6.86	5.98	7.48	2.058	2.044	85.94	61.74

Effective splice length (critical bolt) 4.3 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.8. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 4.00				MARION 3 lb/ft post - 80ksi *							
Dist to bolt A (in) 1.38				Nested splice							
Dist to strain gauge (in) 8.88				Critical orientation							
Moment arm (in)73.38											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs	Calc	Base	Obs @ Gauge
Appl Tot											
floor	-0.894	-0.596	2.251								
tight	-2.480	-3.359	2.258			5.09	6.21				
DL	-2.368	-3.231	2.945			4.92	6.01	0.041	0.041	1.90	1.23
60 60	-2.140	-3.288	3.370	0.69	0.69	4.58	6.10	0.306	0.297	12.46	9.17
32 92	-2.015	-3.321	3.581	0.43	1.12	4.39	6.15	0.437	0.434	18.10	13.12
32 124	-1.887	-3.373	3.824	0.50	1.62	4.20	6.24	0.589	0.571	23.73	17.66
32 156	-1.787	-3.427	4.043	0.47	2.08	4.04	6.32	0.725	0.708	29.37	21.75
32 188	-1.694	-3.486	4.280	0.51	2.59	3.90	6.41	0.873	0.844	35.00	26.18
32 220	-1.628	-3.567	4.516	0.52	3.11	3.81	6.54	1.020	0.981	40.64	30.59
32 252	-1.574	-3.641	4.772	0.59	3.70	3.72	6.66	1.179	1.118	46.27	35.38
32 284	-1.547	-3.731	4.995	0.51	4.20	3.68	6.80	1.318	1.255	51.91	39.55
32 316	-1.525	-3.819	5.224	0.55	4.75	3.65	6.94	1.461	1.391	57.54	43.83
32 348	-1.515	-3.928	5.453	0.54	5.29	3.63	7.11	1.604	1.528	63.18	48.11
32 380	-1.513	-4.043	5.696	0.59	5.88	3.63	7.29	1.755	1.665	68.81	52.65
32 412	-1.521	-4.153	5.928	0.58	6.46	3.64	7.46	1.900	1.802	74.45	56.99
16 428	-1.535	-4.256	6.168	0.63	7.08	3.66	7.62	2.049	1.870	77.27	61.47

Effective splice length (critical bolt) 3.8 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.9. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 4.00						MARION 3 lb/ft post - 80ksi *					
Dist to bolt A (in) 1.25						Face to face splice					
Dist to strain gauge (in) 8.75						Critical orientation					
Moment arm (in)72.25											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs	Calc	Base	Obs @ Gauge
floor	1.087	0.702	2.423								
tight	-0.211	-0.368	2.418			2.43	1.91				
DL	-0.097	-0.224	2.375			2.22	1.62	0.041	0.041	1.90	1.23
60 60	0.122	-0.423	1.950	0.87	0.87	1.81	2.02	0.306	0.293	12.45	9.17
32 92	0.220	-0.542	1.735	0.48	1.35	1.63	2.25	0.440	0.428	18.07	13.19
32 124	0.311	-0.684	1.522	0.48	1.83	1.46	2.54	0.572	0.563	23.70	17.17
32 156	0.414	-0.846	1.297	0.51	2.34	1.26	2.86	0.713	0.697	29.32	21.38
32 188	0.515	-1.022	1.089	0.48	2.82	1.07	3.21	0.842	0.832	34.95	25.27
32 220	0.612	-1.210	0.871	0.49	3.31	0.89	3.58	0.978	0.967	40.57	29.34
32 252	0.693	-1.427	0.655	0.50	3.81	0.74	4.01	1.113	1.101	46.20	33.38
32 284	0.762	-1.660	0.431	0.52	4.33	0.61	4.47	1.252	1.236	51.82	37.57
32 316	0.833	-1.890	0.217	0.52	4.85	0.48	4.93	1.386	1.371	57.45	41.57
32 348	0.905	-2.179	-0.039	0.64	5.49	0.34	5.50	1.545	1.505	63.07	46.35
16 364	0.930	-2.301	-0.148	0.28	5.76	0.29	5.74	1.613	1.573	65.89	48.39
16 380	0.968	-2.420	-0.262	0.32	6.08	0.22	5.98	1.684	1.640	68.70	50.52
16 396	1.004	-2.556	-0.390	0.35	6.43	0.16	6.25	1.764	1.707	71.51	52.91

Effective splice length (critical bolt) 4.2 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.10. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Back to Back Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 4.00				MARION 3 lb/ft post - 80ksi *							
Dist to bolt A (in) 1.31				Back to back splice							
Dist to strain gauge (in) 6.88				Non-critical orientation							
Moment arm (in) 72.31											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs	Calc	Base	Obs @ Gauge
floor	-1.330	-0.712	0.041								
tight	-6.482	-3.790	0.011			7.77	4.84				
DL	-6.430	-3.829	-0.053	0.00	0.00	7.69	4.90	0.043	0.043	1.55	1.29
60 60	-6.407	-3.850	-0.481	0.71	0.71	7.66	4.93	0.310	0.303	12.10	9.29
32 92	-6.380	-3.853	-0.685	0.35	1.05	7.62	4.94	0.437	0.442	17.73	13.10
32 124	-6.360	-3.868	-0.902	0.37	1.42	7.59	4.96	0.572	0.581	23.36	17.16
32 156	-6.337	-3.881	-1.119	0.38	1.80	7.55	4.98	0.707	0.719	28.99	21.21
32 188	-6.318	-3.894	-1.327	0.40	2.20	7.53	5.00	0.837	0.858	34.62	25.10
32 220	-6.291	-3.909	-1.574	0.40	2.59	7.48	5.02	0.991	0.997	40.25	29.72
32 252	-6.273	-3.930	-1.804	0.41	3.01	7.46	5.06	1.134	1.136	45.88	34.02
32 284	-6.254	-3.946	-2.004	0.36	3.37	7.43	5.08	1.259	1.275	51.51	37.76
32 316	-6.228	-3.966	-2.256	0.46	3.82	7.39	5.11	1.416	1.413	57.14	42.47
32 348	-6.206	-3.985	-2.485	0.41	4.23	7.36	5.14	1.558	1.552	62.77	46.75
32 380	-6.180	-3.996	-2.708	0.41	4.64	7.32	5.16	1.697	1.691	68.40	50.92
32 412	-6.156	-4.014	-2.935	0.42	5.06	7.28	5.19	1.839	1.830	74.03	55.16
16 428	-6.157	-4.018	-3.053	0.22	5.28	7.28	5.19	1.912	1.899	76.85	57.36
16 444	-6.155	-4.022	-3.152	0.19	5.46	7.28	5.20	1.974	1.968	79.66	59.21
16 460	-6.161	-4.026	-3.623	0.21	5.67	7.29	5.21	2.267	2.038	82.48	68.02
16 476	-6.223	-4.028	-3.377	0.20	5.88	7.38	5.21	2.114	2.107	85.29	63.42
16 492	-6.318	-4.026	-3.476	0.20	6.08	7.53	5.21	2.176	2.176	88.11	65.27
16 508	-6.427	-4.021	-3.596	0.23	6.31	7.69	5.20	2.250	2.246	90.92	67.51

Effective splice length (critical bolt) 4.4 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.11. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Nested Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 4.00				MARION 3 lb/ft post - 80ksi *							
Dist to bolt A (in) 1.75				Nested splice							
Dist to strain gauge (in) 9.25				Non-critical orientation							
Moment arm (in) 73.75											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs	Calc	Base	Obs @ Gauge
floor	-1.347	-0.410	2.283								
tight	-5.958	-4.630	2.249			6.96	6.63				
DL	-5.826	-4.424	2.191	0.00	0.00	6.76	6.31	0.040	0.040	1.89	1.20
60 60	-5.981	-4.284	1.762	0.84	0.84	6.99	6.09	0.307	0.297	12.45	9.22
32 92	-6.064	-4.223	1.558	0.42	1.26	7.12	5.99	0.434	0.434	18.08	13.03
32 124	-6.154	-4.160	1.330	0.48	1.74	7.25	5.89	0.576	0.570	23.71	17.29
32 156	-6.244	-4.108	1.102	0.49	2.23	7.39	5.81	0.719	0.707	29.34	21.56
32 188	-6.283	-4.063	0.891	0.46	2.68	7.45	5.74	0.850	0.844	34.97	25.50
32 220	-5.761	-4.028	0.659	0.51	3.19	6.66	5.69	0.995	0.981	40.60	29.84
32 252	-5.743	-3.997	0.406	0.50	3.68	6.63	5.64	1.152	1.117	46.23	34.56
32 284	-5.771	-3.978	0.205	0.43	4.11	6.67	5.61	1.277	1.254	51.86	38.32
32 316	-5.816	-3.966	-0.029	0.50	4.61	6.74	5.59	1.423	1.391	57.49	42.70
32 348	-5.802	-3.957	-0.252	0.50	5.10	6.72	5.57	1.562	1.528	63.12	46.86
32 380	-5.841	-3.956	-0.474	0.48	5.58	6.78	5.57	1.700	1.665	68.75	51.01
32 412	-5.767	-3.960	-0.685	0.50	6.08	6.67	5.58	1.832	1.801	74.38	54.96
32 444	-5.731	-3.969	-0.907	0.55	6.63	6.61	5.59	1.970	1.938	80.01	59.11

Effective splice length (critical bolt) **

Effective splice length (both bolts) **

* Nominal yield stress

** Bolt gauge slipped at 35 ksi - data omitted

Table F.12. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 4 Inch Face to Face Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 4.00				MARION 3 lb/ft post - 80ksi *							
Dist to bolt A (in) 1.38				Face to face splice							
Dist to strain gauge (in) 9.00				Non-critical orientation							
Moment arm (in) 72.38											
LOAD (lbs)	Ch.#1 Ch.#2 Ch.#3			Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
	Appl Tot	(mV)	(mV)			(mV)	Bolt A	Bolt B	Obs	Calc	Base
floor	1.094	0.708	2.235								
tight	-0.351	-1.517	2.226			2.70	4.19				
DL	-0.292	-1.424	2.308			2.59	4.00	0.041	0.041	1.90	1.23
60 60	-0.526	-1.224	2.738	0.89	0.89	3.03	3.61	0.309	0.293	12.46	9.27
32 92	-0.643	-1.131	2.938	0.42	1.31	3.25	3.42	0.434	0.427	18.10	13.01
32 124	-0.766	-1.044	3.133	0.42	1.73	3.48	3.25	0.555	0.561	23.73	16.65
32 156	-0.915	-0.950	3.345	0.45	2.18	3.76	3.06	0.687	0.696	29.37	20.61
32 188	-1.089	-0.851	3.577	0.50	2.68	4.08	2.87	0.832	0.830	35.00	24.95
32 220	-1.295	-0.755	3.815	0.51	3.19	4.47	2.68	0.980	0.964	40.64	29.40
32 252	-1.479	-0.653	4.038	0.50	3.69	4.81	2.47	1.119	1.099	46.27	33.57
32 284	-1.691	-0.541	4.275	0.54	4.23	5.21	2.25	1.267	1.233	51.91	38.00
32 316	-1.923	-0.431	4.520	0.57	4.79	5.65	2.03	1.419	1.368	57.54	42.58
16 332	-2.033	-0.358	4.646	0.31	5.10	5.85	1.89	1.498	1.435	60.36	44.93
16 348	-2.134	-0.275	4.760	0.29	5.39	6.04	1.73	1.569	1.502	63.17	47.06
16 364	-2.240	-0.218	4.877	0.28	5.67	6.24	1.61	1.642	1.569	65.99	49.25
16 380	-2.337	-0.163	4.985	0.26	5.93	6.42	1.50	1.709	1.636	68.81	51.27
16 396	-2.441	-0.100	5.099	0.29	6.21	6.62	1.38	1.780	1.704	71.63	53.40
16 412	-2.576	-0.039	5.245	0.36	6.57	6.87	1.26	1.871	1.771	74.44	56.13
16 428	-2.685	0.022	5.360	0.32	6.89	7.08	1.14	1.943	1.838	77.26	58.28

Effective splice length (critical bolt) 4.1 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.13. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Back to Back Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 5.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.38				Back to back splice							
Dist to strain gauge (in) 10.25				Critical orientation							
Moment arm (in)73.38											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
floor	-0.741	-0.628	1.762								
tight	-2.413	-2.146	1.764			2.56	2.39				
DL	-2.399	-2.156	1.838	0.00	0.00	2.54	2.40	0.039	0.039	1.90	1.17
60 60	-2.343	-2.141	2.258	0.80	0.80	2.46	2.38	0.301	0.290	12.46	9.02
32 92	-2.344	-2.127	2.492	0.39	1.19	2.46	2.36	0.446	0.424	18.10	13.39
32 124	-2.334	-2.119	2.709	0.38	1.56	2.44	2.34	0.582	0.558	23.74	17.45
32 156	-2.323	-2.115	2.934	0.39	1.95	2.43	2.34	0.722	0.692	29.37	21.66
32 188	-2.311	-2.119	3.145	0.35	2.30	2.41	2.34	0.853	0.826	35.01	25.60
32 220	-2.295	-2.140	3.383	0.41	2.70	2.39	2.38	1.002	0.960	40.64	30.05
32 252	-2.277	-2.250	3.625	0.43	3.13	2.36	2.55	1.152	1.093	46.28	34.57
32 284	-2.253	-2.357	3.851	0.40	3.53	2.32	2.72	1.293	1.227	51.91	38.80
32 316	-2.231	-2.460	4.083	0.41	3.94	2.29	2.88	1.438	1.361	57.55	43.13
32 348	-2.207	-2.575	4.309	0.42	4.36	2.25	3.06	1.579	1.495	63.18	47.36
32 380	-2.182	-2.716	4.533	0.42	4.77	2.21	3.28	1.718	1.629	68.82	51.54
32 412	-2.146	-2.861	4.794	0.41	5.18	2.16	3.51	1.881	1.763	74.45	56.42
32 444	-2.121	-3.016	5.039	0.47	5.65	2.12	3.75	2.033	1.897	80.09	61.00
32 476	-2.088	-3.183	5.323	0.56	6.21	2.07	4.01	2.210	2.031	85.73	66.31
32 508	-2.058	-3.323	5.557	0.52	6.73	2.03	4.23	2.356	2.164	91.36	70.68
32 540	-2.015	-3.449	5.839	0.56	7.29	1.96	4.43	2.532	2.298	97.00	75.96
32 572	-1.979	-3.599	6.113	0.58	7.87	1.91	4.67	2.703	2.432	102.63	81.08
16 588	-1.961	-3.670	6.240	0.28	8.15	1.88	4.78	2.782	2.499	105.45	83.45
16 604	-1.939	-3.752	6.382	0.31	8.46	1.85	4.91	2.870	2.566	108.27	86.10

Effective splice length (critical bolt) ** in

Effective splice length (both bolts) ** in

* Nominal yield stress

** Bolt gauge nearing end of life - data omitted

Table F.14. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Nested Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 5.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.38				Nested splice							
Dist to strain gauge (in) 10.00				Critical orientation							
Moment arm (in)72.38											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
App Tot											
floor	-0.784	-0.548	2.034								
tight	-2.985	-2.982	2.007			3.32	3.82				
DL	-2.786	-2.895	2.092	0.00	0.00	3.02	3.69	0.039	0.039	1.90	1.17
60 60	-2.627	-2.935	2.496	0.75	0.75	2.78	3.75	0.291	0.287	12.46	8.72
32 92	-2.542	-2.950	2.709	0.41	1.16	2.65	3.77	0.423	0.420	18.10	12.70
32 124	-2.461	-2.969	2.917	0.41	1.57	2.53	3.80	0.553	0.552	23.74	16.59
32 156	-2.391	-2.981	3.126	0.42	1.99	2.42	3.82	0.683	0.684	29.37	20.50
32 188	-2.333	-3.012	3.317	0.38	2.37	2.34	3.87	0.802	0.817	35.01	24.07
32 220	-2.272	-3.063	3.547	0.47	2.84	2.25	3.95	0.946	0.949	40.64	28.37
32 252	-2.242	-3.116	3.761	0.44	3.28	2.20	4.04	1.079	1.081	46.28	32.37
32 284	-2.212	-3.193	4.009	0.51	3.78	2.15	4.16	1.233	1.213	51.91	37.00
32 316	-2.192	-3.248	4.209	0.42	4.20	2.12	4.24	1.358	1.346	57.55	40.74
32 348	-2.173	-3.359	4.468	0.52	4.73	2.10	4.42	1.519	1.478	63.18	45.58
32 380	-2.167	-3.458	4.706	0.53	5.25	2.09	4.57	1.668	1.610	68.82	50.03
32 412	-2.155	-3.556	4.954	0.52	5.77	2.07	4.73	1.822	1.743	74.45	54.67
32 444	-2.149	-3.658	5.217	0.57	6.34	2.06	4.89	1.986	1.875	80.09	59.58
32 476	-2.152	-3.762	5.461	0.55	6.88	2.06	5.05	2.138	2.007	85.73	64.14
32 508	-2.153	-3.883	5.713	0.57	7.45	2.07	5.24	2.295	2.139	91.36	68.85
32 540	-2.161	-3.972	5.938	0.54	7.98	2.08	5.38	2.435	2.272	97.00	73.06
32 572	-2.172	-4.101	6.229	0.69	8.67	2.09	5.58	2.617	2.404	102.63	78.50

Effective splice length (critical bolt) ** in

Effective splice length (both bolts) ** in

* Nominal yield stress

** Bolt gauge nearing end of life - data omitted

Table F.15. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Face to Face Splice in Critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 5.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.88				Face to face splice							
Dist to strain gauge (in) 10.50				Critical orientation							
Moment arm (in) 72.88											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
App Tot											
floor	1.105	0.723	0.870								
tight	-0.043	-0.612	0.798			2.15	2.65				
DL	-0.092	-0.630	0.723	0.00	0.00	2.25	2.68	0.040	0.040	1.90	1.20
60 60	0.104	-0.775	0.320	0.77	0.77	1.88	2.97	0.291	0.288	12.54	8.73
32 92	0.212	-0.851	0.103	0.40	1.17	1.68	3.12	0.426	0.420	18.21	12.79
32 124	0.308	-0.936	-0.113	0.43	1.61	1.50	3.29	0.561	0.553	23.89	16.83
32 156	0.399	-1.023	-0.324	0.43	2.04	1.32	3.46	0.692	0.685	29.56	20.77
32 188	0.479	-1.123	-0.539	0.44	2.47	1.17	3.66	0.826	0.817	35.23	24.79
32 220	0.549	-1.220	-0.732	0.40	2.87	1.04	3.85	0.947	0.949	40.91	28.40
32 252	0.616	-1.335	-0.945	0.44	3.31	0.92	4.08	1.079	1.082	46.58	32.38
32 284	0.676	-1.454	-1.153	0.44	3.74	0.80	4.31	1.209	1.214	52.26	36.27
32 316	0.734	-1.595	-1.365	0.45	4.19	0.70	4.59	1.341	1.346	57.93	40.23
32 348	0.789	-1.753	-1.568	0.44	4.63	0.59	4.91	1.467	1.479	63.61	44.02
32 380	0.829	-1.911	-1.757	0.41	5.03	0.52	5.22	1.585	1.611	69.28	47.56
32 412	0.878	-2.079	-1.995	0.45	5.48	0.43	5.55	1.733	1.743	74.96	52.00
16 428	0.892	-2.153	-2.043	0.19	5.66	0.40	5.70	1.763	1.809	77.79	52.90
16 444	0.909	-2.251	-2.145	0.25	5.91	0.37	5.89	1.827	1.875	80.63	54.81
16 460	0.928	-2.336	-2.256	0.23	6.14	0.33	6.06	1.896	1.942	83.47	56.88

Effective splice length (critical bolt) 5.1 in

Effective splice length (both bolts) N/A

* Nominal yield stress

Table F.16. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Back to Back Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 5.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.75				Back to back splice							
Dist to strain gauge (in) 10.25				Non-critical orientation							
Moment arm (in)73.75											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
App Tot											
Floor	-0.789	-0.645	1.897								
tight	-2.437	-2.551	1.892			2.49	2.99				
DL	-2.435	-2.504	1.837	0.00	0.00	2.36	2.99	0.039	0.039	1.90	1.17
60 60	-2.405	-2.492	1.425	0.70	0.70	2.31	2.98	0.296	0.292	12.52	8.87
32 92	-2.384	-2.484	1.211	0.38	1.08	2.28	2.96	0.429	0.426	18.18	12.87
32 124	-2.366	-2.478	0.984	0.41	1.49	2.25	2.95	0.570	0.561	23.85	17.11
32 156	-2.353	-2.475	0.762	0.41	1.89	2.23	2.95	0.709	0.696	29.51	21.26
32 188	-2.345	-2.470	0.548	0.40	2.29	2.22	2.94	0.842	0.830	35.18	25.26
32 220	-2.337	-2.465	0.328	0.41	2.69	2.21	2.93	0.979	0.965	40.84	29.38
32 252	-2.333	-2.462	0.090	0.44	3.13	2.20	2.93	1.127	1.100	46.50	33.82
32 284	-2.331	-2.453	-0.140	0.43	3.56	2.20	2.91	1.271	1.234	52.17	38.12
32 316	-2.338	-2.446	-0.375	0.43	3.99	2.21	2.90	1.417	1.369	57.83	42.52
32 348	-2.357	-2.434	-0.594	0.42	4.41	2.24	2.88	1.554	1.504	63.50	46.61
32 380	-2.449	-2.423	-0.801	0.40	4.81	2.38	2.87	1.683	1.638	69.16	50.48
32 412	-2.596	-2.403	-1.042	0.49	5.29	2.60	2.84	1.833	1.773	74.83	54.98
32 444	-2.749	-2.383	-1.257	0.44	5.73	2.83	2.80	1.967	1.908	80.49	59.00
32 476	-2.873	-2.354	-1.463	0.44	6.17	3.02	2.76	2.095	2.042	86.15	62.85
32 508	-3.012	-2.326	-1.681	0.47	6.64	3.23	2.72	2.231	2.177	91.82	66.93
32 540	-3.131	-2.288	-1.921	0.53	7.17	3.41	2.66	2.380	2.312	97.48	71.41
32 572	-3.282	-2.238	-2.220	0.69	7.86	3.63	2.58	2.567	2.446	103.15	77.00

Effective splice length (critical bolt) ** in

Effective splice length (both bolts) ** in

* Nominal yield stress

** Bolt gauge nearing end of life - data omitted

Table F.17. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Nested Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 5.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.38				Nested splice							
Dist to strain gauge (in) 10.19				Non-critical orientation							
Moment arm (in)72.38											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
App Tot											
floor	-0.804	-0.597	2.210								
tight	-1.735	-1.805	2.213			1.40	1.90				
DL	-1.715	-1.668	2.149	0.00	0.00	1.37	1.68	0.039	0.039	1.90	1.17
60 60	-1.856	-1.523	1.744	0.76	0.76	1.59	1.46	0.291	0.290	12.46	8.74
32 92	-1.920	-1.461	1.537	0.41	1.17	1.68	1.36	0.420	0.424	18.10	12.61
32 124	-1.973	-1.405	1.338	0.38	1.55	1.76	1.27	0.544	0.558	23.74	16.33
32 156	-2.040	-1.360	1.121	0.41	1.96	1.86	1.20	0.680	0.692	29.37	20.39
32 188	-2.096	-1.323	0.901	0.43	2.39	1.95	1.14	0.817	0.826	35.01	24.50
32 220	-2.187	-1.303	0.677	0.43	2.82	2.09	1.11	0.956	0.960	40.64	28.68
32 252	-2.274	-1.286	0.451	0.44	3.26	2.22	1.08	1.097	1.094	46.28	32.91
32 284	-2.356	-1.274	0.242	0.41	3.67	2.34	1.06	1.227	1.228	51.91	36.81
32 316	-2.458	-1.265	0.013	0.46	4.13	2.50	1.05	1.370	1.362	57.55	41.10
32 348	-2.530	-1.260	-0.169	0.37	4.49	2.60	1.04	1.483	1.496	63.18	44.50
32 380	-2.635	-1.258	-0.381	0.44	4.93	2.76	1.04	1.615	1.630	68.82	48.46
32 412	-2.747	-1.262	-0.582	0.42	5.34	2.93	1.04	1.741	1.764	74.45	52.22
32 444	-2.858	-1.268	-0.794	0.47	5.81	3.10	1.05	1.873	1.898	80.09	56.18
32 476	-2.979	-1.280	-1.014	0.50	6.31	3.28	1.07	2.010	2.032	85.73	60.29
32 508	-3.093	-1.298	-1.228	0.51	6.81	3.45	1.10	2.143	2.166	91.36	64.29
32 540	-3.201	-1.318	-1.420	0.49	7.30	3.62	1.13	2.263	2.300	97.00	67.88
32 572	-3.319	-1.344	-1.627	0.53	7.83	3.79	1.17	2.392	2.434	102.63	71.75
16 588	-3.369	-1.364	-1.755	0.33	8.16	3.87	1.21	2.471	2.501	105.45	74.14
16 604	-3.432	-1.383	-1.876	0.32	8.48	3.96	1.24	2.547	2.568	108.27	76.40

Effective splice length (critical bolt) ** in

Effective splice length (both bolts) ** in

* Nominal yield stress

** Bolt gauge nearing end of life - data omitted

Table F.18. Results of 72 Inch Bending Test: Marion 3 lb/ft - 80 ksi Post; 5 Inch Face to Face Splice in Non-critical Configuration (Calibrated Bolts).

BENDING TEST											
Splice length (in) 5.00				MARION 3 LB/FT POST - 80 ksi *							
Dist to bolt A (in) 1.38				Face to face splice							
Dist to strain gauge (in) 9.81				Non-critical orientation							
Moment arm (in)72.38											
LOAD (lbs)	Ch.#1 (mV)	Ch.#2 (mV)	Ch.#3 (mV)	Tip Defl (in)	Total Defl (in)	BOLT LOADS (kips)		STRAIN At Gauge (uin/in)		STRESS (ksi)	
						Bolt A	Bolt B	Obs.	Calc.	Base	Obs @ Gauge
App Tot											
floor	1.084	0.765	0.791								
tight	0.522	0.136	0.745			1.05	1.25				
DL	0.657	0.467	0.816	0.00	0.00	0.80	0.59	0.040	0.040	1.90	1.20
60 60	0.318	0.604	1.244	0.88	0.88	1.44	0.32	0.307	0.288	12.46	9.20
32 92	0.136	0.641	1.463	0.45	1.33	1.78	0.25	0.443	0.421	18.10	13.29
32 124	-0.041	0.668	1.681	0.44	1.76	2.11	0.19	0.579	0.554	23.74	17.37
32 156	-0.218	0.694	1.898	0.44	2.20	2.44	0.14	0.714	0.687	29.37	21.41
32 188	-0.385	0.713	2.107	0.43	2.63	2.76	0.10	0.844	0.819	35.01	25.33
32 220	-0.574	0.736	2.345	0.48	3.11	3.11	0.06	0.993	0.952	40.64	29.78
32 252	-0.767	0.754	2.582	0.47	3.58	3.47	0.02	1.140	1.085	46.28	34.21
32 284	-0.949	0.759	2.816	0.49	4.07	3.81	0.01	1.286	1.217	51.91	38.58
32 316	-1.139	0.761	3.045	0.48	4.55	4.17	0.01	1.429	1.350	57.55	42.86
32 348	-1.327	0.763	3.264	0.47	5.02	4.52	0.00	1.565	1.483	63.18	46.96
32 380	-1.511	0.760	3.472	0.46	5.48	4.87	0.01	1.695	1.615	68.82	50.84
32 412	-1.736	0.759	3.730	0.58	6.06	5.29	0.01	1.856	1.748	74.45	55.67
16 428	-1.825	0.761	3.836	0.25	6.31	5.46	0.01	1.922	1.814	77.27	57.65
16 444	-1.950	0.761	3.980	0.34	6.65	5.69	0.01	2.011	1.881	80.09	60.34
16 460	-2.026	0.760	4.072	0.21	6.85	5.83	0.01	2.069	1.947	82.91	62.06
16 476	-2.118	0.761	4.194	0.30	7.15	6.01	0.01	2.145	2.013	85.73	64.34
16 492	-2.219	0.759	4.324	0.31	7.46	6.20	0.01	2.226	2.080	88.54	66.77
16 508	-2.298	0.760	4.426	0.26	7.72	6.34	0.01	2.289	2.146	91.36	68.68

Effective splice length (critical bolt) 5.4 in

Effective splice length (both bolts) 5.4 in

* Nominal yield stress